PUBLISHED

AT NO. 9 MURRAY STREET, NEW YORK.

Telephone Call: Murray 586. Cable Address: "Electrical," New York.

Western Office, 23 Borden Block, Chicago.

W. J. JOHNSTON, Editor and Publisher.
N. S. KEITH, Associate Editor, Scientific Department.
T. C. MARTIN, " " News Department.
E. P. THOMPSON, " " Patent Department.
CLARENCE E. STUMP, Business Manager.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.00.

(Postage Prepaid in the U. S. or Canada.)

CLUBS.—In clubs of 4 or more, $2.50 a year each, with a free extra copy to the getter-up of a club of 8. Subscription to foreign countries $4 a year.

In requesting your address changed, give old as well as new address.

THE ELECTRICAL WORLD

HAS THE LARGEST CIRCULATION

OF ANY ELECTRICAL JOURNAL PUBLISHED, AND IS

THE BEST ADVERTISING MEDIUM.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions.
Notices of Situations or Help Wanted, $1 to $3 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Matter for the **Editorial** Department should be addressed to

The Editor of The Electrical World, New York.

Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed simply,

THE ELECTRICAL WORLD, New York,

Or when more convenient, they can be sent to the Chicago office.

CONTENTS.

	Page.
A Chronological Record of Expiring Electric Motor Patents—II	33
ILLUSTRATED ARTICLES:	
Electric Lighting Underground	34
Electrical Measurements	35
EDITORIAL PARAGRAPHS	31
MISCELLANEOUS:	
Review of Electrical Events and Progress in 1884 (Concluded)	32
Electric Transmission of Power in Boston	32
The Electric Light Considered Irreligious	32
On Protection from Electric Currents	32
Batteries with Insoluble Anodes	33
A Costly Storm	34
Storing and Transmitting Power	36
The Telephone Patent Interferences	37
Electric Gas-Lighting Patent Suits	37
Mr. Edison as an Electrical Littérateur	38
DEPARTMENTS:	
Western Notes	38
The Telegraph	39
The Telephone	39
The Electric Light	39
Miscellaneous Notes	39
Applications of Power	39
Stock Quotations	39
Business Notices	39
Our Illustrated Record of Electrical Patents	40

New Advertisements.

G. H. Stout & Co.—Miniature Electric Lamps i
Electricité—Scientific Review iii
Lumley Electric Light and Power Supply Co.—Dynamos and Lamps iv
Edw. E. Harbert & Co.—Harbert Telephone v
"X Y Z"—Business Manager Wanted v
"D."—Salesman Wanted v
"Electricity"—Glassblower Wanted v
Sebastian, May & Co.—Lathes v
Warren Webster—Castings v
Sun Electric and Illuminating Co.—Incandescent Lamps v
T. P. Reineck & Co.—Sounder Attachment v
Duffy Publishing Co.—What a Dime will do viii

REARRANGED ADVERTISEMENTS.

New York Safety Steam Power Co.—Steam Engines i
L. G. Tillotson & Co.—Job Lot of Electric Bells i
Schleicher, Schumm & Co.—"Otto" Gas Engine vii

Vol. V. NEW YORK, JAN. 24, 1885. No. 4.

EVERYBODY seems to be wanting to read the new book by Messrs. Maver and Davis, on the "quad." Its simple, easy style, and the clearness with which it explains knotty difficulties, have called forth the warmest commendations from telegraphers.

PROF. A. E. DOLBEAR supplements in this issue his recent article in our columns on personal safety with electric currents, by describing some experiments with oil on his hands. He thinks there is no limit to the strength of current that might be met in this way, or with oiled gloves.

WE publish to-day a number of interesting notes from our Chicago branch office. We would again remind our Western readers that the representative of this journal will at all times be glad to see them there, and that all items of news, advertisements, subscriptions or orders for books intrusted to him will receive immediate attention.

THE electrical transmission of power is a matter rapidly coming to the front. We publish to-day some very interesting notes on what has already been done in Boston by a local company using the Daft system. Printers, stamp-works, blackboard manufacturers, trunk and bag makers, and other parties are using the power just as they want it, for work or ventilation, and independently of each other.

THE late severe weather has made many a superintendent and manager wish that his wires were underground. Last Saturday's storm snapped the wires in every direction, and there was a good deal of delay during the morning after the gale. Our Chicago correspondent reports the effect in the West. The fact that, with fifty miles of electric street lights, the only damage done by crossing of the wires was under $100 speaks volumes for the care with which the circuits have been run. It is strange, too, that that damage was caused at the headquarters of the Fire Department on Mercer street.

AN observant correspondent in Europe writes us that the Vienna telephone people have a practical way of putting up their wires, using neither poles nor house-tops, and yet not going underground. There are affixed to the walls of the houses, on either side of the street, small and very neat iron frames, holding from 8 to 16 porcelain insulators. The wires are then strung along the fronts of the buildings, on these insulators, between the second and third story windows. The whole presents a very neat and even pretty appearance, the wires being inconspicuous on account of their smallness.

TELEPHONE managers in various parts of the country are making good reports of increasing business. We stated a couple of weeks ago that the exchange at Erie, Pa., had increased from 174 subscribers to 317, a net gain of 143 in twelve months, in a population of 27,000. Mr. Francis, the manager, has good reason for congratulating himself, but Kansas City puts forward an even better showing. The exchange there has increased in a year from 451 subscribers to 867, a net gain of 416, or 92.2 per cent. This rate of growth is highly creditable to Mr. Charles W. Price, the manager, who has evidently made good use of his opportunities in the thriving Western city.

DISCUSSING lately in these columns, in connection with some serious accidents, the best means for the lighting of mines with safety, we pointed out the various peculiar and special recommendations of the incandescent lamp. At present, the instances of underground electric lighting are not numerous, but we have every reason to believe that they will increase. We publish to-day an interesting description, by Mr. C. Edward Reynolds, a young English electrical engineer now in this country, of an installation that he made recently in a railway tunnel through the Mantiqueira Mountains of Brazil. We think that Mr. Reynolds' unaffected, straightforward narrative is enough in itself to convince our readers that the future of electric lighting in mines, shafts and tunnels is very promising.

ACCORDING to a dispatch from London on the 20th, a sub-committee of the Stock Exchange has recommended that the Exchange Telegraph Company be deprived of facilities for obtaining quotations to be sent out on the "tickers." It has been said that there are at least ten "bucket shops" close to the London Exchange, and thirty more scattered around the city in out of the way places; and this blow is therefore aimed at such establishments. The fight appears to be similar to that waged here. We observe, however, that the governing committee of the New York Stock Exchange has given directions to cut off all telegraphic and telephonic communication between the exchange and the Petroleum Exchange and Stock Board. This extends the area of the battle-ground.

FROM time to time we have acknowledged the receipt of maps of the Dominion from Mr. F. N. Gisborne, F. R. S., the superintendent of the Canadian Telegraph and Signal Service. Sheet No. 4, showing British Columbia, and completing the series, has now reached us, and we congratulate Mr. Gisborne on the success of the undertaking. These maps, which have been prepared under his immediate supervision from the latest geographical surveys, show all the telegraph lines and stations throughout the Dominion, as well as all the cables landing along the coast. Map No. 4 includes also a reduced but beautiful map, showing the principal telegraph lines and cable connections throughout the world. We do not feel surprised at the anxiety of governments, boards of trade, societies, telegraph companies, colleges and schools, to obtain copies of these highly valuable publications.

A WESTERN commercial paper remarks: "Already in Great Britain there is a commercially successful electric railway; underground telephone and telegraph wires are everywhere in use, and the electric light has been adapted to household purposes to a greater extent than on this continent. In fact, in applying electricity to every-day uses the old country has beaten the new." While we think that England hardly gets its due for steady advancement, this is rather too strong, and we see no reason for disparagement of American enterprise. There is vastly more electric lighting in New York than in any English city, and there are hundreds of telephones in use in American homes to one in English homes. Very few English towns know what a telephone exchange is. Underground telephone and telegraph wires are not everywhere in use in England, by any means. Three electric railways were in operation here last year, and one is running now. In England next to nothing is known of the convenient district telegraph system or the admirable burglar alarm service.

WE believe firmly that electrical stocks generally are destined to receive great attention in the near future. While most branches of trade and industry have fallen off and been depressed since 1882, electrical applications have been the subject of a steadily increasing demand, and to-day there are more telegraph lines, more telephones, more electric lights, more district telegraph boxes, more burglar alarms, more dynamos and more batteries in use than there ever were before, and the percentage of increase is still maintained. We may quote as one instance of activity the Thomson-Houston Company, who are obliged to keep on running their works night and day on electric lighting plants, and still fall behind their orders. Their plants in a single State—Pennsylvania—increased over 250 lights in the last thirty days. The reports we publish from Chicago show that activity prevails there, too. An industry, then, that can grow in all its branches, despite the dullness of the times, is one that cannot but attract capital, especially when banks are full of money for which no use has been found.

AN important decision has just been rendered by the Court of Appeals of this State, to the effect that the tax on the franchise of the Western Union Company and the Gold & Stock Telegraph Company applies to the total amount of their capital stock, and not alone to that portion of it representing their property in this State. The referee in his report to the court decided that the tax was due with interest, but the court modifies the judgment by dropping the claim for interest. As we understand it, the tax under the law of 1881 is laid on the capital stock of corporations, and the rate is adjusted to the dividends paid. It is not a tax on property but on corporate franchises. The text of the decision has not yet been made public. It is said that nearly a million dollars of unpaid taxes will be collected on the strength of it—not a small sum even for the Western Union Company and the other corporation. The elevated railroad people have lately moved out of the city to escape what they hold to be unfair taxation. Perhaps the Western Union Company may feel inclined to move out of the State for similar reasons.

TWO weeks ago we gave some particulars of electric lighting development in New Zealand. The progress in Australia has been far more rapid. The Australasian Electric Light and Power Company has carried out 32 installations, employing 319 arc and 1,295 incandescent lights. The Australian Electric Company has carried out 16 installations, employing 60 arc and 2,132 incandescent lights, and has effected sales of lighting plant in 15 instances, chiefly to mining companies. This is promising, but, so far, the stockholders are not happy, as both companies have not yet earned dividends. At the last meeting, in London, the chairman said lugubriously: "They had all been under the impression that it was going to be a good thing for them, but they had learned to their sorrow that it was the reverse. The only gleam of satisfaction to him was that it might have been much worse." This was all the consolation he could offer, and it was very sourly received. All the same time, however, he drew a picture of the improving outlook, and does not seem to have been at all over sanguine. Electric lighting has certainly passed through its worst days.

WHAT Mr. Edison thinks or says is always of interest. He is an original genius, with a free and easy expression, a copious flow of language, and a knack of uttering quaint things. The portions of his article that we quote to-day from the Boston *Herald*, in which it appears as "copyrighted," will therefore be turned to with curiosity by our readers. We imagine that Mr. Edison does not write his own State papers, and we certainly fail to find evidence of his natural, personal style in the diffuse, verbose, high-flown and poetical article before us. Still, it bears his name, and may be accepted as the latest exposition of his views on the leading electrical questions of the day. Mr. Edison sketches the history and development of the principal applications, examines their chances of growth, and closes by remarking that "to discuss the possibilities would bring into play a line of speculation seemingly more akin to the dreams of the poet than to the sober judgment of the practical worker." Notwithstanding the liberal indulgence in dithyrambs, the article has many good points of comment and suggestion. Mr. Edison expects nothing very novel or startling in telegraphy, but looks for a vast increase in telephony and lighting, and a "boom" in the transmission of power. He touches lightly on the question of storage.

Review of Electrical Events and Progress in 1884.

(*Concluded from page* 12.)

The four leading departments of electricity to-day are telegraphy, telephony, electric lighting and the application of power. These we have already treated in our review. Another department coming into prominence and closely related to all the others is that of

UNDERGROUND WIRES.

The question of burying electric wires was very warmly discussed and agitated during the year in all parts of the country, but the opposition to aerial lines was most active and pronounced in the State of New York. After a vigorous winter campaign in the newspapers the contending parties resumed hostilities in the Legislature, and at last a bill was carried through the Assembly and Senate providing that telegraph, telephone, electric light and similar wires should be placed underground in cities of this State of not less than 500,000 people, the companies owning the wires to remove and bury them before November, 1885, under pain of having the local authorities step in and do the work for them at their expense if the law were not obeyed; and providing also that the laying of wires underground should not be made a monopoly. This was signed, after some delay, by the Governor. Meantime, the Underground Wires Committee appointed to consider the question, and including representatives of all the New York companies interested, brought its labors to a close, reporting that it had examined more than 600 patents and plans, and had found that a tunnel large enough to allow all the wires to be placed so that they could be examined or repaired presented the only solution of the problem. The committee also advised the formation of a State commission having power to deal with the matter.

Since the passing of the law, the interpretations of it have varied, and the general conclusion arrived at is that it must undergo modification so that only trunk lines need be buried. Inquiry showed that the companies were willing and able to do that, but would find it utterly impossible to put every branch or way wire out of sight. In New York and Brooklyn the telephone exchanges have undertaken extensive underground work, and now wait for results. It may be mentioned, as part of this general subject, that the Western Union pneumatic tube service, of four brass tubes running up Broadway from "195" to the new offices on Twenty-third street and Fifth avenue, was completed and used experimentally.

In Philadelphia the fight was hot and long, but in spite of threats and fines from the local authorities, most of the wires remained overhead up to the end of the year. Several systems were tried, however, with varying success. In Washington very extensive underground operations were carried out, and the close of the year saw about 300 miles of underground wires for different purposes in fairly successful use throughout the national capital.

The number of companies springing up to carry out underground schemes was large, and one well-known English company, manufacturing cables and using a special system, established itself in New York. There can be no doubt that the movement begun in 1884 is one of importance, and is destined to go on until all, or nearly all, trunk lines running through cities and other large centres are put underground, and the unornamental poles are no longer conspicuous in our streets.

THE INTERNATIONAL ELECTRICAL EXHIBITION.

The great event of the year was the International Electrical Exhibition, held at Philadelphia under the auspices of the Franklin Institute. A large and handsome building was constructed specially on the outskirts of the city, and extensive preparations were made for the occasion. The exhibition opened on September 2, and was not closed until October 11. About 2,500 electrical inventions, instruments, machines, etc., were on exhibition and in constant operation. The weather was excessively hot nearly the whole of the six weeks; but notwithstanding that and the distance of the building from the city proper, the attendance was over 300,000, the largest number of visitors on any day being 16,624. According to the latest figures published, the Institute cleared a cash profit of about $10,000 on the Exhibition. It also secured a valuable memorial library of electrical works, to which publishers contributed largely, and it was presented with apparatus by some of the exhibitors. The general management of the Exhibition reflected much credit on the Institute. The electrical industries of the country were represented without exception, and there was also among the attractions a fine display of apparatus of foreign make. While the Exhibition did not bring any startling novelties to light, it was extremely interesting and instructive, and it will always be remembered with pleasure by American electricians. In connection with the Exhibition, a

NATIONAL CONFERENCE OF ELECTRICIANS

was held under the auspices of the commission appointed by the government for the purpose, with Prof. Rowland, of Johns Hopkins University, as its president. This conference was held during the exhibition in the lecture room of the building and at the Franklin Institute, and its proceedings were participated in by the leading electricians of this country, as well as by a number of such distinguished visitors as Sir William Thomson, Prof. Forbes, Prof. Silvanus P. Thompson and Mr. W. H. Preece. The discussions were of the most interesting nature, and lasted a week. The subjects brought forward were atmospheric electricity, earth currents, electrical units, the theory of the dynamo-electric machine, instruments of measurement and precision, secondary batteries, electric lighting, telegraphy, telephony, long-distance telephony, metallic circuits, underground wires, photometry, the electrical testing of structural metals, lightning rods, the use of electricity in mining and in warfare, and several others. We have already finished the publication of our full report of the conference, and it is felt everywhere that by this bringing together of scientists and practical men the interests of electrical investigation and application have been materially advanced.

In connection, also, with the exhibition, the American Association for the Advancement of Science held its annual meeting at Philadelphia, and prominence was naturally given by it to electrical questions, such as the Hall effect and telephonic communication between vessels at sea. The American Institute of Electrical Engineers was provided with rooms in the exhibition building for the convenience of members, and held a meeting at which several good papers were read and discussed. Altogether, the congregation of scientists in Philadelphia during September and October was one the like of which is hardly to be expected again.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

This national society was formed early in the year, receiving the hearty support of electricians, capitalists and others interested in the science and art. It was modeled after the Civil, Mechanical and Mining Engineers' societies, and, so far, the meetings of the members and of the Council have been held in the house of the Civil Engineers, East Twenty-third street, New York. The Institute held one meeting at Philadelphia, as mentioned above. It now has about 300 members and associates. An electrical society was also established during the year at Cincinnati.

AMERICAN ELECTRICAL EXHIBITION, BOSTON.

It was thought that as the Philadelphia Exhibition was so successful, an exhibition of the same kind might succeed in Boston. The attempt was made at the close of the year at the Massachusetts Charitable Mechanics' Association building in that city, but the Exhibition does not appear to have enjoyed the local patronage that it deserved.

Electric Transmission of Power in Boston.

The Massachusetts Electric Power Company started recently in Boston an installation which we believe to be the largest plant in the country, where the electric transmission of power is the sole object. It is undoubtedly one of the most advanced steps taken in electrical applications. The company was organized last spring by several prominent business men of Boston, on a business basis and for business purposes. They bought exclusive use of the "Daft system" of electric lighting and transmission of power from the Daft Electric Light Company, New York, for the State of Massachusetts.

In May a 6 horse-power generator was placed at 12 Federal street, Boston, and connections were made with a 3 horse-power receiver at the printing house of J. S. Adams, 299 Washington street, and the stamp works of Dimond & Co., 22 Milk street. A month later, the former moving, the receiver was changed to the printing house of Newman & Mansfield, 43 Kilby street. These establishments have been in continual successful operation.

The Massachusetts Company, within a few months, absolutely satisfied in regard to the practicability of the system, and clearly seeing the immense possibilities and value of the same, at once ordered the largest dynamo the Daft Company then manufactured, with its proper complement of receivers. While the order was being filled, active work was commenced upon the construction of a main line. After a great deal of hard work, tact and determined effort, a line of "00" wire was built from 197 Congress street, where the company obtained their power, over house-tops to Cornhill, a distance of about three-quarters of a mile. From this main line the proper taps were taken with No. 4 wire to the various subscribers. The difficulty of stringing such a wire can only be appreciated by those who have had some experience in such matters, especially as the wires run over some of the highest buildings in the city.

It might be here mentioned that the construction was intrusted to Mr. P. A. Dowd, an electrical constructing engineer of high repute and long experience, a gentleman who has done a great deal of constructing for many telegraph, telephone, electric light companies, and for the police and fire departments.

The Daft Company shipped the large dynamo and its receivers a few months ago, but, owing to unavoidable delays, everything was not ready till the latter part of December. This machine is differentially wound, permitting of a wide range of current strength, to be automatically varied, according to external requirements, and of very low internal resistance.

The normal speed of armature is 768 revolutions, its maximum electromotive force is 123 volts, and its working strength of current 300 ampères. The total weight of the dynamo is 4,200 lbs., the armature weighing 450 lbs.

Obviously, the number of receivers run depends upon their aggregate power. Nine have been shipped for this 50 horse-power dynamo, varying from ½ horse-power to 10 horse-power. They are operated in multiple. On Dec. 25, the old 6 horse-power dynamo was stopped, and its subscribers were connected to the new mains, with three new subscribers. One of these was W. H. Chandler, printer, 21 Cornhill, using a 6 horse-power receiver. From this establishment a countershaft runs into an adjacent building, from which two other parties get power—a trunk and bag manufacturer and a machine shop. P. A. Swasey, a blackboard manufacturer, 35 Pemberton square, uses a 4 horse-power receiver, and the Boston Safe Deposit and Trust Company, 87 Milk street, use a 2 horse-power motor for ventilating the vaults. This fan deserves especial notice. The armature shaft and fan shaft are *one*, thus doing away with all countershafting, belting, etc. A hand regulating switch is placed upon the wall within easy reach. By this means the room can be ventilated as desired, with speeds varying from nothing to 500. The neatness and simplicity of this arrangement make it perfection.

These five places have thus been operated since Dec. 25 1884, to the satisfaction of all the subscribers. They are all dependent upon the system, and are pleased with the beauty of it in comparison with the individual troubles of operating by steam, gas, compressed air, caloric or any other type or form of energy. Other receivers will be rapidly added. The subscribers, of course, are absolutely independent in regard to each other, using the power when and as long as they please.

The simplicity and perfection of such a system needs no words of commendation. Its rapid extension and general use are inevitable.

G. W. M.

The Electric Light Considered Irreligious.

We mentioned a few weeks ago that the electric light was considered irreligious by some of the ecclesiastical authorities of Rome, and had therefore been banished from one of the churches. A letter from Rome gives the following explanation of the occurrence: On the 11th day of December, 384, the Roman Church was in great mourning, for Damasus, the great friend of Hieronymus, was dead.

The recent celebration of St. Damasus has been quite an event for Rome. The three aisles of the basilica were literally covered with flowers and lights. Nearly 200 chandeliers and 2,000 tapers burned in the temple, and from the cupola a stream of electric light illuminated the tiara and the keys, which pontifical emblems were towering over the great baldachin under which lies the body of the saint. A crowd of little gilded wooden angels supported at regular intervals all along the aisles rich festoons of flowers. From the seven niches of the side aisles hung alternately chandeliers and baskets of flowers. The decoration was so tasteful and so rich that many criticised it as being too profane, and even suggested that the presence of the electric light in the church, together with so many flowers and cheerful ornaments, suggested one of the most lively scenes of "Excelsior," which is just now being performed at the Costanzi Theatre.

These criticisms were so persistent and universal that the authorities were obliged to prohibit the electric light, which was used after the first evening only as a means of illumination in the courtyard of the Cancelleria, where the carriages of the cardinals and of the Roman princes were stationed during the religious services.

A bad feeling was created on account of the electric light episode. When the solemnity was over on the 12th, a notice was given to all the clerical papers of Rome warning all the rectors of churches, both in Rome and abroad, against the use of baskets of flowers hanging from the ceiling, and against magnesium, calcium and electric lights. This notice burst like a bombshell and offended every one, but chiefly the chapter of St. Damasus. They did not like it that an animadversion of a spiritual kind should be made known to them and to the Church in general through the papers. Many give the credit of this blunder not to the Congregation of Rites, but to a minor officer, who is badly handled just now in Rome.

On Protection from Electric Currents.

BY PROF. A. E. DOLBEAR.

In my former article I called attention to the personal factor in the handling of wires carrying strong currents of electricity. Afterward, while thinking about it, it occurred to me to test the effect of covering the hands with oil, etc., and noting the difference in the resistance thus produced. My resistance from hand to hand while grasping tightly large metallic handles was found to be 12,000 ohms. Then oiling my hands with common machine oil, and again testing with tight grip with both hands, the resistance was found to be 20,000 ohms. With hands dipped in melted paraffin, the same, but the paraffine peels off and leaves large areas bare. Of course it will occur to any one to use gloves when at work in dangerous places, and I think if one would use oiled gloves, he could handle with impunity wires carrying currents with almost any difference of potential, even Sir Wm. Thomson's idea 80,000 volts. Oftentimes it is impracticable to use gloves when it would be practicable to work with the hands coated with oil or shellac, or some other easily spread substance with high resistance, and thus be protected in otherwise dangerous work.

A Chronological Record of Expiring Electric Motor Patents.—II.

BY F. B. BROCK, WASHINGTON, D. C.

It is a noticeable fact that the drawings of the earlier patents, in some instances, are not very artistic; but in

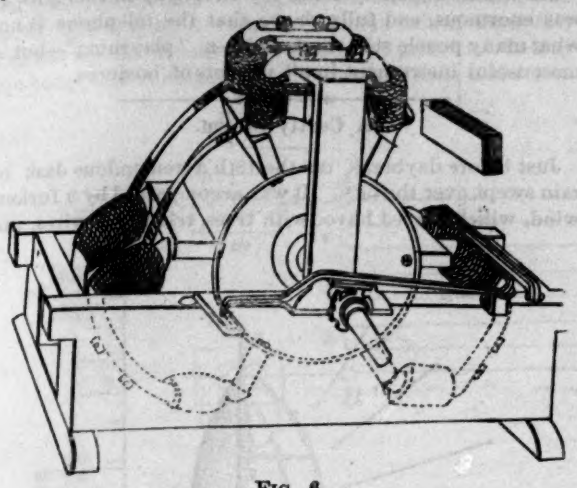


FIG. 6.

order to give a description of these devices with fidelity, I have concluded to present fac-simile reproductions of the original illustrations.

The patent of Truman Cook, of New York, was granted in 1840. The body of the rotating armature is made of wood, brass, or any other material not affected by magnetic influence. Upon the periphery of this armature are placed six rectangular bars of soft iron, at equal distances apart, and extending from end to end parallel with the axis.

The electro-magnets are of the usual horseshoe form, and are placed in pairs, so that the opposite poles of each of them shall, at the same instant, stand immediately over the ends of the two contiguous armatures or keepers. In this machine there are three pairs of electro-magnets.

There are two mercury cups located in the frame in which the ends of the electro-magnet coils terminate, those wires which form one termination passing into one cup, and those forming the opposite electric pole passing into the other mercury cup. A cam wheel secured to the armature shaft is made to contact the terminal wires from one electric pole, so that the ends of the wire are lifted from the mercury cup at each rotation.

The notches which are shown in this cam wheel corre-

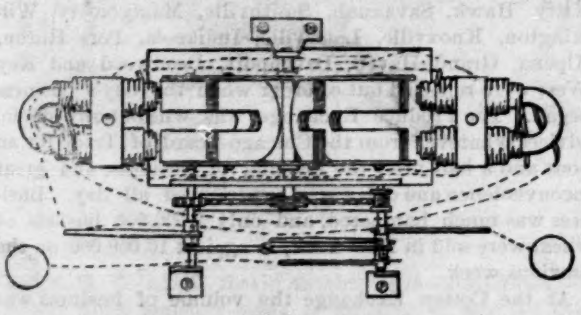


FIG. 7.

spond with the number of the revolving armatures, and are so arranged as to suspend the transmission of the electric current, and, consequently, the magnetic induction at the proper moment for allowing the armatures to pass the magnets. One of the projecting teeth on the cam is insulated, and it is this one that raises the terminal wires of one electric pole by the action of the cam.

In the drawings these wires are not represented as dipping into the mercury cup, but as resting upon a piece of metal which forms a conducting communication with the cup.

The length of the several armatures is less than that of their distance from each other, and the north and south poles of the magnets, constituting each pair, are at a distance apart corresponding to the distance of the armatures. The influence of the magnetic arch is consequently exerted between the opposite poles of the magnets constituting the pair, this resulting from their proximity being greater than that of the opposite poles of each individual magnet. It will be perceived that these magnets operate in pairs,

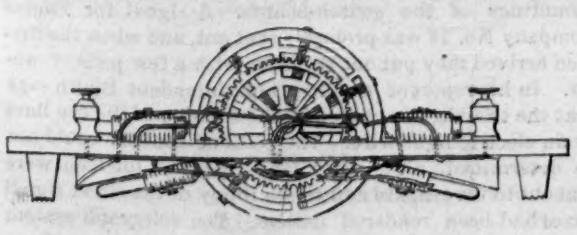


FIG. 8.

one of them extending its influence directly to the other, thus mutually actuating the armatures as they approach.

Mr. Cook shows a modified form of armature in the detail view, which consists of several plates of soft sheet iron, placed side by side, with narrow sheets of sheet copper interposed between them at each end (Fig. 6).

In 1850, John H. Lillie, of Joliet, Ill,, constructed an electric motor comprising a series of radially arranged permanent horseshoe magnets, revolving on a wheel in proximity to stationary electro-magnets (Figs. 7 and 8). A helix of fine wire is wound around the outside of the electro-magnet, "for the double purpose," it is said, "of producing other electro-magnets, and to destroy the secondary or vibratory currents in my first electro-magnet."

On one end of the axis of the wheel to which the permanent magnets are attached is a large spur-wheel, which drives two pinions to which the commutator is attached. The frame of the machine receives two stationary electro-magnets on a line radial from the shaft, one on each side. Around the usual coils of the electro-magnets are wound secondary coils which are connected with the electro-magnets placed below the bed-plate of the frame, where they form a circuit and cause the latter magnets to be energized by means of this arrangement. Secondary currents are said to be destroyed in this way. The lower magnets are so placed as to aid in the propulsion of the wheel.

Mr. Lillie found it necessary to have the permanent magnets quite long, otherwise their poles would be changed by a powerful current in the electro-magnet.

Jacob Neff, of Philadelphia, devised an electric motor engine in 1851 (Figs. 9, 10 and 11).

The metal frame of the Neff electric motor is connected by cross-bars, to which the armatures are attached in such a manner that each magnet has a separate armature. The rotating wheel of electro-magnets is secured by means of

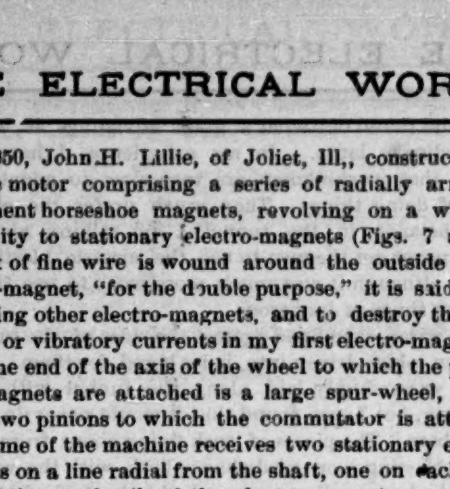


FIG. 9.

insulated nuts in the wheel-frame, which are tapped for the purpose of receiving the magnets.

The commutator is composed of three separate discs. The outside ones have flanges, by means of which they are secured to the shaft, and they are also adjusted, as circumstances may require, by means of set screws, non-conducting substances being placed between the discs. Each disc has sixteen platina points on its periphery, corresponding in number to the armatures.

Friction rollers covered with platina are arranged to work under the commutators, they being retained in their position by set screws above their journals and spiral springs beneath.

The commutators complete the circuit when the battery is connected, and the magnets are energized as they come in contact with the friction rollers and demagnetized as they leave it.

As will be understood, the magnets are energized when

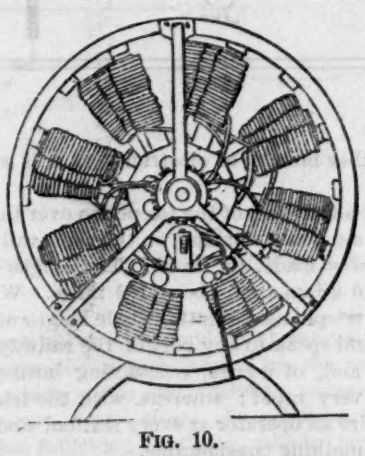


FIG. 10.

their edge is near the edge of the armatures, and continue drawing until the magnets are immediately under or opposite to the armatures. The connection is then broken and the magnets pass freely under the armatures.

The last electric motor which we shall consider in this paper is that granted Thomas C. Avery, of New York (Figs. 12 and 13).

In this electro-magnetic engine, Avery combines a series of electro-magnets in pairs so as to present their poles toward a common centre, sufficient space being provided between the poles of the magnets for an intervening axis. This axis consists of revolving sets of bars extending radially outward and passing between the poles of the magnets. At the points where the ends of the magnets approach the axis, pieces of brass or other non-magnetic material are interposed to prevent the ends of the magnets acting upon the axis. On each side of these collars of brass, at a sufficient distance apart, are arranged on the axis a series of arms between each two of which the legs of the magnet are allowed to pass, and on which they exercise their attractive force alternately as the circuit is made and broken through the opposite pairs of electro-magnets.

Two cams are attached to the rotating axis for the purpose of breaking and changing the direction of the magnetic current from the vertical to the horizontal magnets continuously. Two circuit closers act at their outer ends on these cams by means of compression springs, and are attached at their back ends by a screw to support pieces fixed to the side of the frame. These support pieces are

FIG. 11.

attached to a cross-bar, and are in contact with conducting material secured to the under side of the cross-bar for the purpose of reversing or changing the direction of the electric currents.

(TO BE CONTINUED.)

Batteries with Insoluble Anodes.

M. Grezel, in a recent number of *L'Electricien*, details some of his experiments in devising batteries with insoluble anodes. Among those which gave no practical success was one which consisted of two electrodes of electric light carbon. One of the carbons was immersed in a porous cup containing carbonate of ammonia in solution, and this, with the other carbon, was immersed in acidulated water. Immediately an abundant liberation of carbonic acid gas took place, and quite a strong current was produced, the carbon in the porous cell being the positive pole of the battery.

The following, however, seems to have resulted in a practical battery. In this experiment the carbon was placed in a porous cup and surrounded by slaked lime; the negative carbon dipped into tolerably concentrated hydrochloric acid contained in the outer glass jar. The current obtained was in the same direction as in former experi-

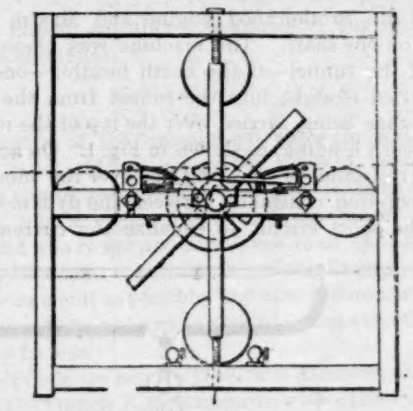


FIG. 12.

ments. The chemical equation of the new couple is very simple:

$$HCl + CaO,HO = CaCl + HO + HO.$$

It will be seen that a considerable number of batteries could be conceived in which it would not be necessary to use zinc as the anode.

All the experiments, and more particularly the first one mentioned above, would seem to contradict the hypothesis regarding the electromotive force of contact; for in that case the two electrodes are absolutely identical and in the

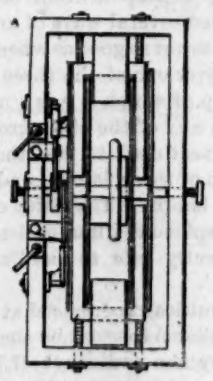


FIG. 13.

same physical condition. M. Grezel thinks that these experiments go to prove that the chemical phenomena taking place in the cells are not only the source of the electric energy, but, in addition, that the reacting bodies are the seat of the electromotive force.

Electric Lighting Underground.

BY C. E. REYNOLDS.

A good deal has been said about underground wires for electric lighting, the telegraph, telephone, etc., and a great deal has also been done during the last year (1884) toward transplanting the overhead wires to tubes and trenches underground, thereby removing the unsightly poles and wires in the streets, and also making it much safer to passengers and also to telephone and telegraph operators. A striking instance of the danger from electric lighting wires being mixed up with others took place on the 17th. During the storm then the different wires became crossed in all directions, and the headquarters of the Fire Department on Mercer street was the scene of what might have been a very serious loss of property, owing to some electric light wires crossing the wires of the Fire Department and setting fire to the switch-boards and wires, and very nearly causing a big fire.

But very little has been said or done with regard to electric lighting underground and the great advantage it has in mining, tunneling, etc., over the ordinary lamps in common use.

We are continually hearing of accidents in coal mines,

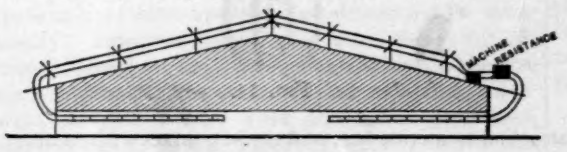


FIG. 1.

owing entirely to the carelessness of some miner who opens his lamp to light his pipe or strikes a match for the same purpose. This ought to be and is preventable. If miners were supplied with lamps which they could not open, most of the accidents, and in fact nearly all, would be prevented.

It is very well known that miners are a reckless set. Although the man knows that the fire-damp is all around him, it will not deter him from opening his lamp and causing explosion after explosion. Now an incandescent lamp cannot be opened, as every one knows, without breaking it. Why should not a lamp of this form take the place of the Davy lamp? The advantages are immense—1st, very much more light; 2d, no danger to be feared from a man opening his lamp; 3d, cheapness. These points of merit have been well illustrated in the construction of a tunnel about one mile long in Brazil, through the Mantiqueira Mountains.

I lighted the tunnel with the Swan incandescent lamp, and thus facilitated the working of the tunnel to such a degree that the extra expense of the electric lighting was more than counterbalanced by the great saving of time due to the extra lighting power.

I used the Brotherhood engine and Maxim dynamo attached on one shaft. The machine was placed at one mouth of the tunnel—at the north heading—one circuit being carried straight into the tunnel from the dynamo and the other being carried over the top of the mountain into the south heading, as shown in Fig. 1. On account of the extra resistance of the long line over the mountain, I placed hoop-iron resistance between the dynamo and the line on the short circuit to equalize the currents. The wires over the mountain were carried on poles and attached to ordinary porcelain insulators. They were bare six-strand copper wires, and the main lead on entering the tunnel was covered with a thick coating of india-rubber and tape, the return wire being left bare.

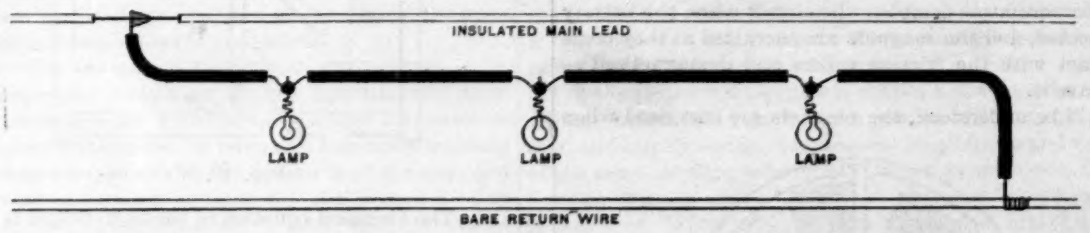


FIG. 2.

The lamps were arranged in groups of three in series, as shown in Fig. 2, and each lamp had a spiral brass spring attached to the top to keep it from being broken by any great shock. I tried several ways of arranging the lamps, but the result was never so good as when they were grouped in threes. Whenever one of the three was broken, it only affected that group of which it was a member. No change was perceptible in any of the other groups.

The greatest current used to run these lamps was 1.34 ampères per group of three lamps, and 13.4 ampères per circuit of thirty lamps. Thus the current was strong enough to give a splendid illumination, and at the same time it was perfectly safe to handle, the electromotive force being low.

One of the difficulties experienced at first was to get the miners (mostly Italians) to work by the light of the Swan lamp, instead of by the ordinary oil lamp. They were afraid of it, and every man would much rather light a piece of dynamite in his hand than touch the insulated electric light wire. But this was a difficulty soon overcome. One or two men got slight shocks and found that it did not hurt them, then they laughed at the others for being afraid of it. Of course, the others soon followed suit, and found out what a great advantage it had over the ordinary lamp. In my experience, I have always found that workingmen are very slow to adopt a new way of doing things. They much prefer the old way. For instance, in the tunnel I am talking about, we could never get the men to use the electric blasting machine, although it was much more work to use the fuse, and ten times as dangerous.

The wires were fixed against the sides of the tunnel by wooden plugs driven into holes bored for them. At first these were simply laid along the tunnel without any covering, but I soon found that it would never do to leave them bare. The pieces of rock flying about from the frequent blasting soon made havoc both with the wires and with the lamps. Some means had to be devised to protect them. In the case of the wires it was easy enough, but with regard to the lamps it was more difficult, as they had to be arranged so that any miner who was going to blast could take them down and stow them away in a safe receptacle himself, as, of course, I could not be in every place at once, and we had no one else who understood anything about it.

The wires I placed in a casing of thick boards right through the tunnel, with a lid that could be easily opened when I wanted to get at the wires.

For the lamps, I bored holes in the roof of the tunnel and inserted a wooden plug, and in that fastened an iron hook. With this arrangement, a miner (as soon as everything was ready to fire the blast) unhooked every lamp in his vicinity, and then he stowed them away in a thick wooden box constructed for the purpose and securely fixed against the side of the tunnel. The connections to the lamps from the main leads were spiral insulated wire, so that there was no danger of the wires breaking from being constantly moved. Six lamps were placed on each machine drill at the two headings. These were arranged with plenty of slack wire, so that the miner could place the light in any position he liked and wherever he wanted it. The great advantage of these lights was shown in this part of the tunnel more than at any other part, as the drills used in boring the holes had to be constantly watched, and the ordinary oil lamps were being incessantly trimmed and fresh oil put in. Even then, with oil lamps, it was extremely difficult to see to work properly, whereas in using the electric lamp the miner could attach it to his cap and it never required attending to. In whatever direction he looked, the ray of the lamp was thrown on the same spot.

When all the holes were drilled and ready for blasting, the machine drills, attached to an iron carriage, were brought about 100 yards away from the heading, together with all the lamps fixed to them.

I have mentioned that the lamps were fixed to the roof. Most of them were arranged in this way, but some also were fixed to the sides of the tunnel as shown in Fig. 3. These could also be detached, if necessary, and placed in a box during blasting.

Every lamp was shielded with a wire frame for further safety, Fig. 3. The whole of these lights worked well from beginning to end, and without a doubt this means of lighting a tunnel during construction will be more fully appreciated the more it is used.

I will just add a few lines on the subject of the telephone, another branch of electricity that is as yet in its infancy.

The great advantage of the telephone over the telegraph was shown me while working on the same railway where the tunnel was made, in Brazil. The length of the railway was 170 kilometres, about 102 miles. We used the Gower-Bell telephone along the whole length of the route. Any one could speak to any part of the railway whenever he pleased, and, of course, transacting business by this means was very rapid; whereas, with the telegraph, we should require an operator at every station, and the delay would be something considerable.

Another work where the telephone showed its great value was between the tunnel and the turbine. This turbine was employed for compressing the air used for working the machine drills in the tunnel, and also for supplying fresh air to the miners. It was about one mile distant from the tunnel, and the air was forced along six-inch iron pipes and collected in a boiler at the mouth of the tunnel, where it could be transmitted into the tunnel in any quantity and at will.

Now, we required some means of communicating from the tunnel to the turbine, and the telephone was just the thing. If anything happened and the supply of air was cut off, the tunnel was notified at once and arrangements made accordingly.

We also used the telephone in operating an inclined plane over the mountain.

This was run by means of a stationary engine at the top working a wire rope both sides of the mountain on a double track, one car going up and the other going down at the same time. We communicated by telephone to the engineer when the car was full and ready to start, and by this means a great many accidents were prevented and the safety of the freight was insured.

The actual saving by using the telephone in this railway was enormous, and fully shows that the telephone is not what many people still think it is—a "plaything"—but a most useful instrument in all matters of business.

A Costly Storm.

Just before daybreak on the 18th a tremendous dash of rain swept over the city. It was accompanied by a furious wind, which played havoc with trees, telegraph wires, unstable chimneys and insecure signs. The wind continued to blow with violence all day. At noon it had reached a velocity of fifty miles an hour. The temperature fell 10° in five hours, and kept on its downward course all day. The gale seriously hampered the business of the several exchanges in this city. The telegraph wires were reported to have been blown down at many places through the West and South, and it was impossible to get messages through during the morning hours to many important points. The wires running to New Haven, Conn.; Provincetown, Mass.; Washington, Atlanta, Galveston, Cape Henry, Charleston, Fort Macon, Hatteras, Jacksonville, Kitty Hawk, Savannah, Smithville, Montgomery, Wilmington, Knoxville, Louisville, Indianola, Port Huron, Alpena, Grand Haven, Davenport, Deadwood and Key West were reported out of order when the day's business began. The Produce Exchange was without any official advices whatever from the Chicago Board of Trade for an hour and a half after the opening of business, and great inconvenience and delay was experienced all day. Business was much hampered, and only 2,000,000 bushels of wheat were sold in New York, as against 10,000,000 on the previous week.

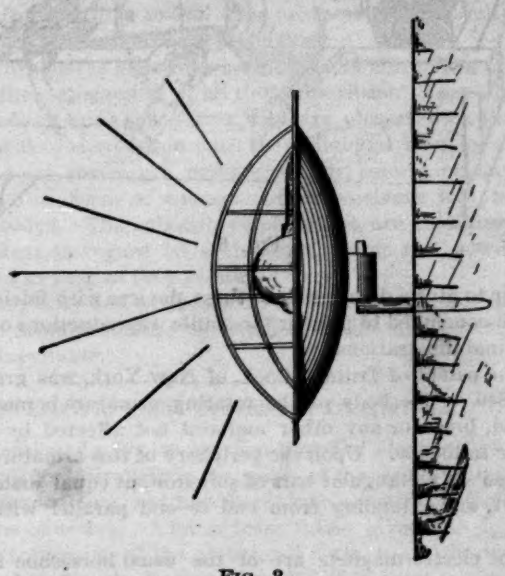


FIG. 3.

At the Cotton Exchange the volume of business was said to be the smallest on record, owing to the fact that no news could be obtained during 'Change hours as to the receipts and prices at southern ports.

At the Stock Exchange a similar complaint was made. Both the Western Union and the Baltimore & Ohio companies refused to accept business messages except at the senders' risk. There was a great deal of inconvenience and delay, especially during the morning hours.

There was a blaze in Firemen's Hall, in Mercer street, and for a time the alarm telegraph system, which is centred there, was in peril. About twelve o'clock, while President Van Cott and Superintendent Smith, of the telegraph bureau, were conversing in the former's office, a peculiar jingling was heard in a telephone box. Superintendent Smith put his hand on the instrument and received a shock that nearly knocked him down. His hand was slightly scorched. At that moment the cry of "Fire!" was heard in the telegraph room up stairs. The operators were busy for a moment in opening six circuits that seemed to be affected by an electric current that was burning out their connections. Before this work was done, flames had made their appearance and were destroying the wooden mountings of the switch-boards. A signal for Engine Company No. 13 was promptly sent out, and when the firemen arrived they put out the blaze with a few pails of water. In his report of the fire, Superintendent Smith says that the trouble was caused by the crossing of the fire lines by an electric light wire. The point of contact could not be determined, although a large force of linemen were sent out to investigate and to see if any of the street signal boxes had been rendered useless. The telegraph system was reported in working order again in two hours. About $100 damage was done to the instruments in the bureau.

The Bone of Contention.—The Western Union Telegraph Company has reduced its rates from New York to points in Texas reached by the Baltimore & Ohio from $1 to 75 cents. This reduction is intended to meet the rates made by the Baltimore on the opening of its Texas lines.

Electrical Measurements.

BY ASSISTANT ENGINEER W. D. WEAVER, U. S. N.

The following apparatus for electrical measurements is very simple and inexpensive, and the results to be obtained are probably not inferior, within the limits of the apparatus, to measurements made with an ordinary galvanometer and resistance-box in the hands of other than a practiced electrician. Owing to its small cost and simplicity, it is of special value to the student of electricity who has not the advantage of laboratory practice. It may also be applied to industrial purposes, the wire and resistances for a particular use being determined by a discussion of the equations.

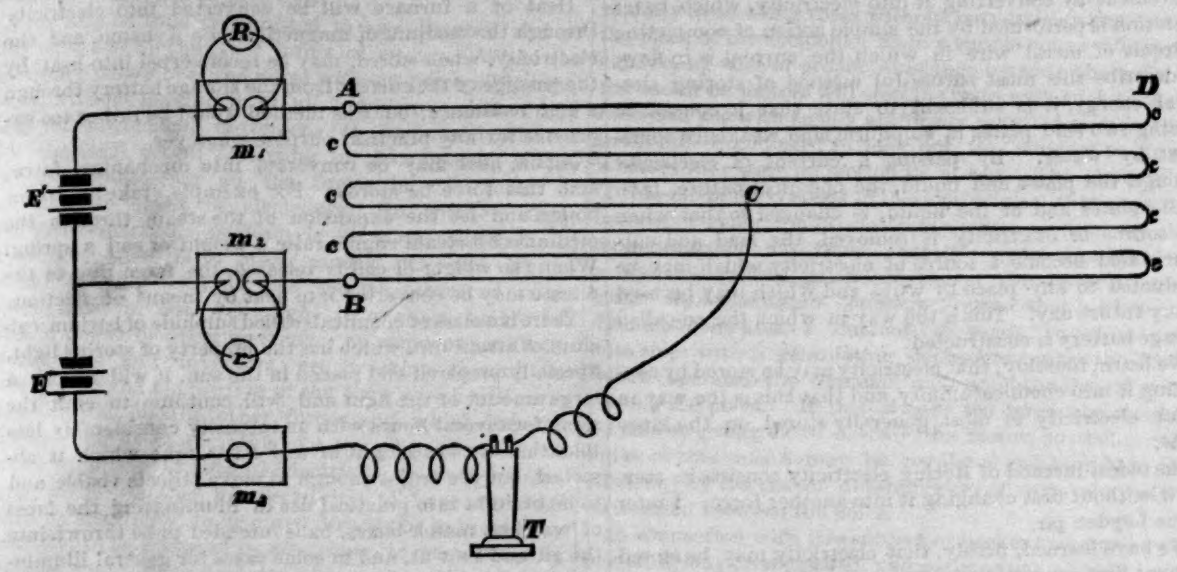


FIG. 1.

In Fig. 1, ABC is a rheocorde consisting of about 10 yards of No. 33 B. W. G. German silver wire, having a resistance of about 50 ohms. At A and B are binding posts, and at c, c are insulated posts made of short lengths of vulcanized rubber tubing, or other suitable insulating material, around which the loops of resistance wire pass; m_1, m_2, m_3 are cups of wood containing mercury; R and T are resistances of about 50 and 15 ohms respectively, which are thrown out of circuit when required by connecting the cups m_1 or m_2 by a stirrup of thick copper wire; E and E' are small standard Daniell

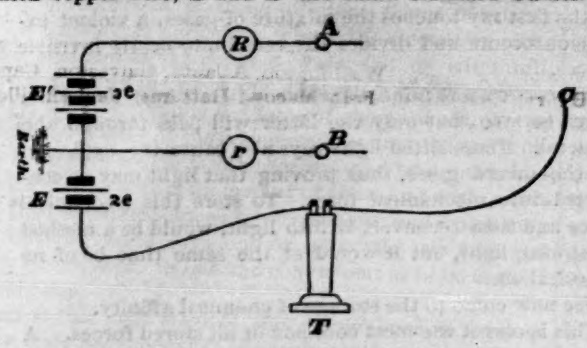


FIG. 2.

cells (E. M. F. = 1.07), five in number; T is a telephone, the old Bell form probably being as efficient as any for this purpose. A paper scale (a metre scale is best) is pasted on the rheocorde board, and the insulated posts so placed in relation to it that allowance may be made for the semi-circumference of wire on each.

In making measurements, the end of one of the telephone wires is touched along the resistance wire until a point C is found such that the telephone gives forth no sound; the distance of the point C from A is then read on the scale and applied in the proper formula.

The deduction of the formulæ that follow may perhaps appear simpler if we consider that a point between E and E' is connected to earth as indicated in Fig. 2; in that case, since $V_1 - V_2 = E'$, if $V_2 = 0$, $V_1 = E'$, and the potential at any point is a direct function of E'.

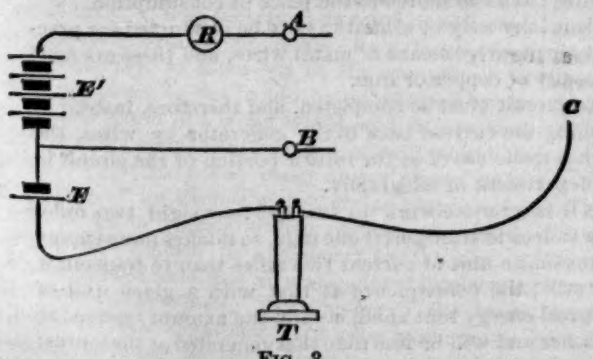


FIG. 3.

I. To obtain the value of the resistance of unit length (AD) of the rheocorde (Fig. 2).

L = total length of resistance wire.
l = length AC (Fig. 1) of resistance wire.
a = resistance of length AD (Fig. 1).
e = electromotive force of each cell.
s = internal resistance of each cell.

1°. When the telephone gives forth no sound, the potential at c is $2e$,

2°. With the resistance R and r both in the rheocorde circuit, the potential at C under the same condition is

$$\frac{R + la}{R + La + r + 3s} \times 3e = 2e. \qquad (1)$$

3°. With the resistance r out of the circuit, the potential at a point C' is

$$\frac{l'a + R}{R + La + 3s} \times 3e = 2e. \qquad (2)$$

From equations (1) and (2) by eliminating R and L we have $a = \frac{2r}{3(l - l')}$, or more general, $a = \frac{Er}{E'(l - l')}$.

II.—*Resistance.*

Solving the above equation, $a = \frac{Er}{E'(l - l')}$, for r, we have $r = \frac{aE'(l - l')}{E}$

III.—*Electromotive Force* (Fig. 3).

s = internal resistance of E.

1°. With one of the Daniell cells at E, following the same reasoning as in I., we have:

$$\frac{R + la}{R + La + s} \times E' = E \qquad (1)$$

2°. Replacing the cell E with the one whose electromotive force x we desire to know, we have:

$$\frac{R + l'a}{R + La + s} \times E' = x \qquad (2)$$

Eliminating L and S, $x = \frac{R + l'a}{R + la} \times E$.

IV.—*Internal Resistance* (Fig. 4).

Having determined the E. M. F., E', of the cell whose internal resistance x we wish to know, it it placed as shown in Fig. 4, in which E is a Daniell cell. The potential at C is

$$E = \frac{R + la}{R + La + x} \times E',$$

$$\text{or } x = \frac{E'}{E}(R + la) - R - La.$$

V.—*Current* (Fig. 5).

The potential at C is E, and the current between A and

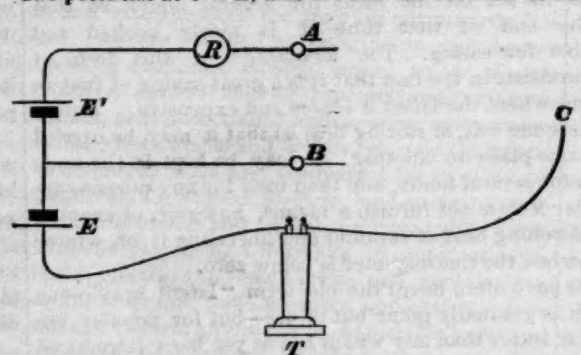


FIG. 4,

C, and consequently the whole current of the closed circuit, is $\frac{E}{la}$.

A large number of measurements of various cells made by the above methods were checked by the ordinary galvanometer, electrometer and condenser methods, and the agreement was very close. In addition, the writer suggests the following methods, which, however, have never been tested to his knowledge, for finding condenser capacities and galvanometer constants.

VI.—*Capacity* (Fig. 6).

The deduction of the formula is much simplified by considering that a capacity is the reciprocal of a resistance, a supposition that a comparison of Ohm's law with the law of capacity will show to be justifiable.

The potential at A is the same as at B when the telephone gives forth no sound.

The potential at A is $\frac{la}{la + \frac{1}{c_1}} \times E.$

The potential at B is $\frac{l_1 a}{l_1 a + \frac{1}{c_2}} \times E.$

Equating and eliminating a and E, we have $c_1 = \frac{l_1 c_2}{l}$.

VII.—*Galvanometer Constants* (Fig. 7).

G = resistance of galvanometer.
S = internal resistance of cells.
θ_1 = first deflection (telephone wire at C).
θ_2 = second deflection (telephone wire at C').
k = galvanometer constant.

1°. Tangent galvanometer.

(a) $$\text{Current} = k \tan. \theta_1 = \frac{E}{la + G + S}.$$

(b) $$k \tan. \theta_2 = \frac{E}{l'a + G + S}$$

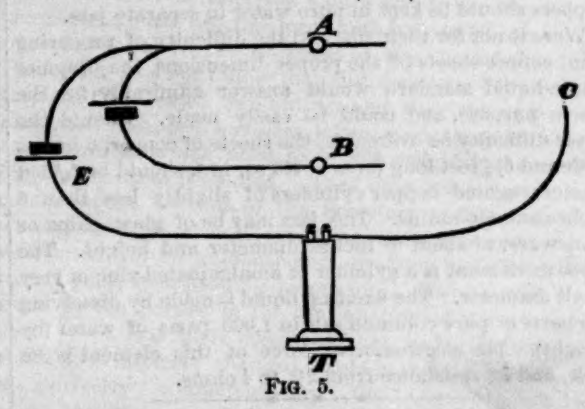


FIG. 5.

Eliminating G and S, we have:

$$k = \frac{\tan. \theta_2 - \tan. \theta_1}{a(l - l') \tan. \theta_1 \tan. \theta_2} \times E,$$

$$\text{or } k = \frac{\cot. \theta_1 - \cot. \theta_2}{a(l - l')} \times E.$$

Similarly for the sine galvanometer:

$$k = \frac{\cos. c\theta_1 - \cos. c\theta_2}{a(l - l')} \times E.$$

For the cosine galvanometer:

$$k = \frac{\sec. \theta_1 - \sec. \theta_2}{a(l - l')} \times E.$$

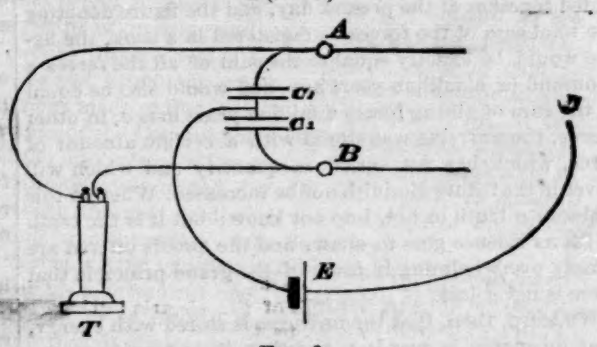


FIG. 6.

For a mirror or other galvanometer for a deflection through a small arc:

$$k = \frac{\theta_2 - \theta_1}{a(l - l')\theta_1\theta_2} \times E.$$

A discussion of the formulæ will show the best arrangement of cells and resistances for a given measurement when the approximate value of the quantity to be measured is known, and a larger number of resistances and cells will extend the range and sensitiveness of the apparatus. The time between experiments (when finding l and l') should be as small as possible, and the difference between l and l' should be as large as possible, that the effect of an error may be less.

The best cells are small cylindrical Daniells, about four inches high (French P. O. standard), with cylindrical zincs. To secure accuracy, the following directions should be observed: For the cells to have a constant electromotive force (1.07 volts) the zincs should be kept well amalgamated, and the solutions frequently renewed. As the charge of the above cells is small, it is advisable not to use

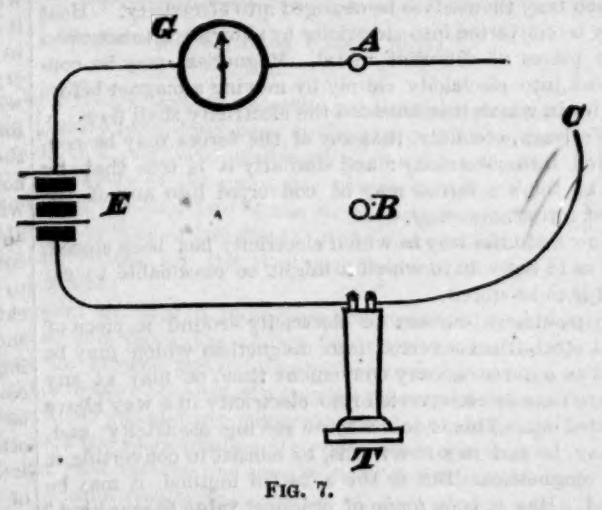


FIG. 7.

the same liquids twice (on different days), if very accurate results are required. It is well to make a quantity of the following solutions and keep them in glass-stoppered bottles: For amalgamation, dissolve 200 parts of mercury in a warm mixture of 750 parts of hydrochloric acid and 250 parts of nitric acid; after the mercury is all dissolved, add 1,000 parts of hydrochloric acid. Simply dipping the zinc

(first scraping well, if new) in the above solution will amalgamate it. The copper solution is made by dissolving to saturation pure copper sulphate in hot water, and the zinc sulphate by dissolving the crystals of that substance in hot water until saturation, and, after cooling, adding an equal bulk of hot water.

The copper plates and stirrups and ends of wires dipping into the mercury cups should be made red-hot and then plunged into ammonia; the latter will then become amalgamated when dipped into the cups.

After the cells have been set up, and before using, they should be put in short circuit for an instant, that they may arrive at their normal state.

When the cells are not in use, the porous jars, zincs and coppers should be kept in pure water in separate jars.

Were it not for their size and the difficulty of procuring thin copper sheets of the proper dimensions, the Reynier single-liquid standard would answer admirably for the above purpose, and could be easily made. Should the latter difficulty be overcome, the sheets of copper, 6 inches wide and 6½ feet long (area = 465 sq. in.), should be folded into corrugated copper cylinders of slightly less than 6 inches outside radius. The jars may be of glass, china or stoneware, of about 6 inches diameter and height. The positive element is a cylinder of amalgamated zinc of very small diameter. The exciting liquid is made by dissolving 250 parts of pure common salt in 1,000 parts of water (by weight). The electromotive force of this element is .82 volt, and its resistance from 2½ to 4 ohms.

Storing and Transmitting Power.*

On the black-board may be seen the words:

ELECTRICITY.
MAGNETISM.
HEAT.
LIGHT.
MECHANICAL FORCE.
CHEMICAL AFFINITY.

These are the names of the six forces existing in the universe. If all the electricity and magnetism and heat and light and chemical affinity in the universe should be added together at the present day, and the figure denoting the total sum of the forces be registered in a book, the figure would be exactly equal to the sum of all the forces a thousand or a million years ago, and would also be equal to the sum of all the forces a million years hence; in other words, the universe was stored with a certain amount of force, which has not varied in quantity and which will never in the future diminish nor be increased. Whether this is absolute truth or not, I do not know; but it is the truth as far as science goes to show, and the proofs offered are simply overwhelming in favor of the grand principle that force is never lost.

We learn, then, that the universe is stored with energy, that no energy is ever lost, and that it is manifested as electricity, magnetism, heat, light, mechanical force and chemical affinity.

To get energy out of the universe and put it to practical use is accomplished by the investigator and the inventor.

It is only occasionally, and at inconvenient times and places, that it is possible to employ the forces of nature for the good of man, and, therefore, it becomes necessary to devise means whereby they may be stored up until they are wanted, or to transmit them to those places where they are to be used.

Electricity is one of the forces which is most useful, and yet it is the one most seldom manifested in nature. It is exhibited in lightning, in the aurora borealis, and in certain fishes. Taken from these sources, it is of no practical value. Further, it cannot be created. Whence, then, may it be obtained, and how may it be stored?

It may be obtained from the other forms of forces by converting them into electricity. Chemical affinity may be converted into electricity by putting two plates of metal into a liquid. Light may be converted into electricity by allowing it to produce certain chemical actions which may themselves be changed into electricity. Heat may be converted into electricity by allowing it to act upon two pieces of different metal. Magnetism may be converted into electricity simply by moving a magnet before a wire in which it is intended the electricity shall flow.

We learn, secondly, that any of the forces may be converted into electricity; and similarly it is true that any one of the six forces may be converted into any of the other forms of energy.

Now as to the way in which electricity has been stored, and as to the way in which it might be reasonable to expect it to be stored.

By passing a current of electricity around a piece of hard steel, it is converted into magnetism which may be used as a force at any convenient time, or may at any future time be reconverted into electricity in a way above pointed out. This is one way of storing electricity; and, it may be said in a few words, to consist in converting it into magnetism. But is this a useful method, it may be asked. Has it been made of practical value to mankind? Certainly it has.

The permanent magnet used in the Siemens telegraph relay, concerning which I spoke to you on the 8th inst., was made in that way. Permanent magnets used in telephones contain stored electricity. Permanent magnets of steel containing stored electricity are used in every scientific college. Dynamos may be constructed by employing permanent magnets for the magnetic field.

We learn, thirdly, that electricity may be stored by constructing a permanent magnet, or, generally, by converting it into magnetism. We have also learned that electricity stored in this manner has been and continually is put to practical use, and is likely to be put to more and more uses as the years go by.

Electricity may be stored by converting it into chemical affinity, and then using the chemical affinity at any time convenient by converting it into electricity, which latter operation is performed by the simple action of completing a circuit of metal wire in which the current is to flow. To describe this most successful method of storing electrical energy, it is sufficient to state that it consists in placing two lead plates in sulphuric acid weakened somewhat by water. By passing a current of electricity through the plates and liquid, the chemical nature, both of the plates and of the liquid, is changed so that when the source of electricity is removed, the lead and sulphuric acid become a source of electricity which may be conducted to any place by wires and which may be used at any future day. This is the way in which the so-called storage battery is constructed.

We learn, fourthly, that electricity may be stored by converting it into chemical affinity, and that this is the way in which electricity is most generally stored on the large scale.

The oldest method of storing electricity consists in storing it without first changing it into another force. I refer to the Leyden jar.

We have learned, fifthly, that electricity may be stored without first converting it into another form of energy.

The question which some one may desire to ask, I will anticipate by asking it myself; but to answer it satisfactorily cannot be done at the present day. Can electricity be stored by converting it into heat and afterward getting the electricity back by transforming it into electricity? Electricity is easily, and in many different ways, converted into heat; but as it is difficult to confine heat after it is obtained, this method has not yet been invented.

In order to invent it, the invention must aim at a method of storing heat and of converting heat into electricity; for there are plenty of ways in which electricity may be converted into heat.

We learn, sixthly, that electricity has not been successfully stored by converting it into heat; and that the reason is that there is no commercially successful method of transforming heat into electricity.

Electricity may be converted also into light; but as light cannot be converted efficiently into electricity, and as there is no probability of its being accomplished on a commercial scale, there is no encouragement to hope of electricity being stored in the form of light.

As heat promises to be in the future the most successful way of storing electricity, it may be interesting to dwell longer upon this part of the subject, and show the earlier and later methods of storing heat.

In the colder regions of the North, meat is said to be cooked in a box lined with black felt and closely shut, the same being first heated to the cooking point in an oven and then put aside. The heat contained in the box continues to act on the meat for several hours, so that at the end of that time it is nicely cooked and suitable for eating. The advantage of this form of oven consists in the fact that it is a great saving of fuel in regions where the latter is scarce and expensive. Herein consists one way of storing heat so that it may be carried from one place to another, or may be kept in the same place for several hours, and then used for any purpose desirable; it does not furnish a means, however, of keeping the scorching heat of summer and liberating it on winter days when the thermometer is below zero.

You have often heard the old term "latent heat"—one which is gradually going out of use—but for popular use it is far better than any which has as yet been introduced in its place. It requires heat to melt iron, or sugar, or crystals of any chemical nature, or ice, or any solid. Now, where does this heat go? It was before mentioned that no force is ever lost, and that it may be converted into one of the remaining forces. In this case of melting solids, it is not converted into any other force, but is given out again when the liquid solidifies. This is the reason why it always becomes warmer when the moisture of the air is converted into snow; so that if the air is not extra cold to begin with, the very act of the formation of the snow causes the air to become so warm as to put an end to the snow-storm by converting it into a rain-storm. According to this principle a room may be heated. The most convenient crystals are those of sodic acetate. They may be placed in one of two concentric pipes, through the other of which may be circulated for a time superheated steam, which melts the crystals. Let the source of heat or steam be removed, and the pipes be taken into the cold room which it is desired to warm. All the heat which was put into the crystals to melt them escapes into the air again when the melted substance changes into crystals, and a great quantity of heat is radiated for several hours without any more loss than if the room were warmed directly by the steam pipe, which latter operation would be inconvenient in horse cars, elevated railway cars, and in other cases where it is advantageous to use stored heat for ordinary heating purposes. The heat could also be used for all the ordinary purposes for which it is at present employed.

These two methods of storing heat are seen to consist in storing it without changing it into any of the other forms of energy; and, further, it does not remain stored for an indefinite period of time.

The question may be asked whether heat can be stored in a similar manner to the method of storing electricity. There is no practical way now, but that is no reason why there should not be.

Heat of a furnace will be converted into electricity through the medium of magnetism in a dynamo, and the electricity, when stored, may be reconverted into heat by the passage of the current from the storage battery through a high resistance; but this method would be rather too expensive for any practical purpose whatever.

Again, heat may be converted into mechanical force, and this force be stored. For example, take a steam boiler, and let the expansion of the steam through the medium of a steam engine raise a weight or coil a spring. When the weight or coil is released, the force due to the release may be converted into heat by means of friction.

There is a class of chemicals called sulphide of barium, calcium or strontium, which has the property of storing light. Specially prepared and placed in the sun, it will absorb a large amount of the light and will continue to emit the same for several hours with an intensity considerably less than that of the sunlight or any other light which it absorbed, but yet bright enough to make objects visible and to be brought into practical use in illuminating the faces of watches, match-boxes, balls intended to be thrown into the air and shot at, and in some cases for general illuminating purposes. As light may be converted into the other forces, then when those forces can be stored it will become possible to store light in them as a medium.

This certainly would form a novel method of illuminating our houses, offices, factories, etc. What could be more reasonable than to expect that in the near future we will take a little of the superabundance of the light of the day and store it away to be used in the night-time?

One of the most interesting experiments in science is that which illustrates that light may be converted into mechanical force. What person by means of his imagination alone would ever think that there is any force in light?

Take two vessels, the one filled with chlorine and the other with hydrogen. Mix these gases in one vessel, and throw it from a dark room into the sunlight. Just as soon as the first ray touches the mixture of gases, a violent explosion occurs and divides the vessel into nearly invisible pieces.

There are some minerals which will sift heat rays from light rays so that only the latter will pass through the mineral. These sifted light rays also cause the explosion of the mixed gases, thus proving that light may be converted into mechanical force. To store this mechanical force and then reconvert it into light, would be a method of storing light, but it would at the same time be of no practical use.

We now come to the storage of chemical affinity.

This is one of the most common of all stored forces. A piece of coal of a cubic foot contains enough chemical affinity to do a wonderful amount of work when united with the oxygen of the air. The elements of the coal are united by this force, and when they separate to unite in different proportions and with the oxygen, this force is, as it were, liberated in the form of heat energy, which expands the steam to drive the engine.

The force of the engine may be stored up in a lifted weight or coiled spring, or in the form of any of the other kinds of energy, and then at any convenient time reconverted into chemical affinity.

In reference to the transmission of power from one place to another, it becomes evident that one method of accomplishing it is to store the power and carry it in that condition,

Another method consists in conducting the force, in whatever form, by means of some material medium leading from the source to the place of consumption.

Electricity may be said always to be conducted for practical purposes by means of metal wires, and these are most generally of copper or iron.

The circuit must be completed, and therefore, instead of bringing the current back to the generator by wires, the earth is made use of as the return portion of the circuit in the department of telegraphy.

As it takes more work to transport a weight two miles than it does to transport it one mile, so it takes more energy to transmit a unit of current two miles than to transmit it one mile; the consequence is that with a given unit of electrical energy sent along a wire, the amount received at the other end will be less than that generated at the source; and as the distance increases the electrical energy decreases in the same ratio. As it has already been stated that energy is never lost, the question is: where does the electricity go?

In passing over or on or through the material of the wire it sets the molecules in vibration. These vibrations are so rapid that the molecules rubbing or falling against one another produce heat. The smaller the wire the hotter it becomes; so that, to retain the maximum amount of electrical energy, the wire must be just so large that the

*Abstract of lecture delivered at Cooper Union, 22d inst., before the Polytechnic Association of the American Institute, by Edward P. Thompson, M. E.

heat is not noticeable. How wonderful is it that, over such a small wire as may be bent by a child, it is possible in an instant to carry electrical energy from one building to another, or from one town to another, or from one country to another. But electrical energy is of no direct value except in very few cases, such as an auxiliary medical treatment where the current is passed through the body, so that it may be asked, of what use is it to be able to transmit electricity?

If heat or light or mechanical force or chemical affinity could be sent over a wire, then transmission of power would be wonderful at first sight.

Heat *may be* thus transmitted to any distance, and so may light and all the other forms of energy. While the electricity passes over the wires without perceptibly heating it, without making it at all luminous, without any signs of mechanical movement or force, and without any chemical action corroding or decomposing it, the wire is transporting all the forces in the form of the invisible agent of electricity. No wonder, then, that this remarkable medium is so much talked about; no wonder there is so much money put into it; no wonder it vies with all the special means of transporting heat in one way, light in another, and other forms of power by other methods; no wonder that all the investigators and inventors are working toward the development and application of the force which will carry along with it all the other forces, and which does this with the rapidity of a fraction of a second in all cases; no wonder we prefer to ride by electricity, to read by electricity, to be warmed by electricity, to have our food cooked by electricity, to be cured directly or indirectly by electricity, to be wakened by electricity, to be warned by electricity, in short, to have done for us by electricity all that which tends to our happiness, long life and prosperity.

But how can one obtain a clear idea concerning the wire carrying all the forms of energy when it carries apparently only the electrical form?

Experiment will best prove this; therefore, let the current of electricity be passed through a fine wire and the wire will become so hot as to burn the hand. Substitute a finer wire, and it becomes so bright as to illumine the surrounding space. Pass the current through a solution of gold obtained from the mine, and the fine, pure metal separates as by magic. Coil some of the wire, of whatever size, about a soft piece of iron, and the force of magnetism will turn a driving wheel, which may be employed to do all the various kinds of mechanical work imaginable; and yet the source of all these different forms of energy may be situated at a furnace where the electricity picks up the heat and light; or at a water-fall or wind-mill, where it picks up the mechanical force; or at the galvanic battery, where it obtains the force of chemical affinity; or at any one or more of these sources of energy, where it obtains electricity which may be transported by a mere wire to any distance, within an instant of time, and with a loss more than counterbalanced by advantages; and which may then be reconverted into one or all of the six forms of energy by means so simple and convenient as to be desired by every one.

Even at this early stage of this comprehensive form of energy there are thousands of people employing it to their benefit. The electric railway probably offers the greatest inducement of transporting it in the form of mechanical force. In the objectionable steam locomotive system of traveling and carrying baggage, we notice that the locomotive itself, with the boiler and coal and water and machinery, weighs from twenty to forty tons. What an enormous power it takes to move this weight. The locomotive should be left at home, where it belongs, and its force be carried, and not that which generates the force. Another advantage is seen in the general principle that ten steam engines cost considerably more than one engine of the same total power. Further, no smoke is made, and the rumbling sound is much less. The train is not obliged to move in a comet's tail of poisonous gases, such as the carbonic oxides; no stopping for coal and water is occasioned; a fireman is not needed on every train; and in similar ways it is cheaper to run one large engine than several small ones. Cheap fuel, such as wood or soft coal, may be employed without objection, in a large plant situated, if necessary, in some out of the way place. In many cases the steam engine could be substituted by the very economical power of a water-wheel, and, in conjunction with a suitable storage battery, a wind-mill would do good service. There are not so many duties placed upon the engine man of an electric motor, giving him thereby more time to watch signals and to regulate the speed. Traction may be obtained in sufficiency by the use of a small motor on each axle, and all manipulated by electric switches near the engine man. The stopping of the train by this means becomes simplified. The same wire conveying the current to propel the train might be employed for transmitting messages from one train to another, or from the train to any part of the country. The same current could be employed easily for lighting the train with incandescent electric lamps. At a future day the cars will be heated by the same force which propels and lights them.

Another use of the current over the same wire would be the operation of the signals on the train and along the track. Imagination carries us perhaps a little in advance of the present generation, to the time when we see a railroad and train passing upon it without an engine man, the trains, or perhaps separate cars, at intervals of a few yards behind one another, regulating their own speed, and minding automatically all the signals much better than the defective eye of the present engine man, and stopping and starting automatically, to let off and take on passengers at the various stations, while on a separate track we see an especial service of cars traveling along entirely without human life and carrying all kinds of freight and cattle, everything being so arranged and automatic that should one car break down all those immediately behind would slacken up with such rapidity as to bring them without harm within one foot of the place of the accident. Such a simple act as placing a conducting wire of proper resistance between the poles of the motor or motors will stop the train with such suddenness, and yet with such a uniformly retarded motion, that the people would need to look out the window to know whether they were in motion or at rest. The philosophy of this car-brake consists in these principles: that a motor becomes a generator of electricity when operated by the momentum of the train; that the short-circuiting of a dynamo-electric generator causes the latter to generate its maximum current; and that when a dynamo generates a current it tends to stop, and does stop with a retardation dependent upon the force which operates the dynamo, and upon the size of wire joining the poles. If this wire is too large, the current may be so strong as to destroy the motor, so that a car-brake of this nature may be regulated and limited in its efficiency by the use of different sizes of wire adapted to be inserted between the poles.

In connection with this subject of brakes and storing of power, it may be suggested, and perhaps has already been anticipated by more than a score of men, that the short-circuiting current might be switched through a small storage battery, so that the current thus stored could be reversed and switched through the motor to assist in starting the train; or the current might be stored in any other way or for any other purpose, instead of wasting it in heating the short-circuiting wire. A storage battery employed for this purpose should be connected up in parallel, so as to offer little resistance.

At the present day gas passing through the street and brought into the houses for lighting and heating purposes is common in this and other countries. It is a great convenience, and before the time of the introduction of the age of electricity gas was considered a luxury; but as gas serves especial purposes, and needs a pipe for its conveyance, while electricity serves not only for heating and lighting, but also for mechanical power, chemical reactions, and all of them combined, the latter cannot but be introduced for the general use of the public in their dwellings, offices, factories and other buildings. When it is introduced thus, there will be brought into the market at high prices many of the patents which are now lying dormant simply because people have no electricity to operate them with, and new inventions for entirely new uses will spring up faster perhaps than they are called for, but more likely less quickly than they could be sold and put into use.

In view of people having at their command, in the near future, an electric current provided here and there with switches for turning it on and off, as though it were gas or water, and with rheostats for drawing out more or less as desired, we are enabled to imagine in our houses electric sewing machines, electric mouse traps, electric coffee grinders, electric clothes washers and wringers, electric lights, electric cooking and heating stoves, electric elevators, electric bells and alarms, electric chairs and beds to be employed as an easy equivalent for physical exercise, electric dumb waiters, electric loud-speaking telephones, electrical pianos and organs connected with a central instrument played by a musician or automatically, electric baths, electric games and tricks and experiments, and other innumerable to-be-invented amusements, toys and ornaments, electric automatic or adjustable locks and latches for doors and windows, electric call systems, electric refrigerators, electric fire extinguishers and everything else which depends for its production, operation or existence upon the several forms of energy called electricity, magnetism, heat, light, mechanical force and chemical affinity.

The Telephone Patent Interferences.

The Commissioner of Patents has rendered an important decision in the matter of the petition filed in behalf of Thomas A. Edison to determine the status of interference heretofore declared between himself and Blake and Drawbaugh, the subject matter of the interference being the combination in a telephone of a metallic diaphragm and an elastic pad or muffler. In this case the Secretary of the Interior overruled the decision of Commissioner Marble, and restored Edison to the position in interference from which he had been deposed by that decision. The action of Drawbaugh's counsel raised a question as to the scope of the decision of the Supreme Court in the case of the Commissioner of Patents against the United States *ex rel.* Hoe & Co., where it was held that the Secretary had no legal authority to revise the decision of the Commissioner of Patents. Drawbaugh's counsel desired that the decision of the Secretary of the Interior, in which the decision of Commissioner Marble was reversed and the interference between Drawbaugh and Blake continued, should be treated as a nullity; that the decision of the Commissioner should be allowed to stand as the judgment of the office, and that the interference between Drawbaugh and Edison should stand dissolved. Counsel for Messrs. Blake and Edison contended that, under the circumstances and in conformity to well-settled principles of law, the judgment of the Secretary should not be disturbed. In his decision, rendered Jan. 14, Commissioner Butterworth says:

"Admitting as true the abstract legal proposition that the decision of the Supreme Court was to the effect that the Secretary had not the legal authority to sit as a court of review to revise the decisions of the Commissioner of Patents, it does not follow that the decision of the Secretary shall be treated as a nullity, and that the case shall stand as if no appeal had been taken, since there are other considerations which must have due weight in determining the questions presented. The Commissioner upon the receipt of the decision of the Secretary in this case, forwarded the same without comment to the examiner of interferences, for his guidance and direction in hearing the interference, then pending before him. No objection was made by the parties to the continuation of the taking of testi It is fairly presumed that rights have intervened and interests changed hands in the meantime. It is perfectly competent for the Commissioner to adopt the decisions of the Secretary, rendered on a case appealed to him, and to direct that all further proceedings in such cases shall conform thereto. Since the decision of the Supreme Court referred to, a number of persons who had prosecuted appeals to the Secretary, and were disappointed in the result, have appeared to open up the cases before the Commissioner, with a view to having the decisions of the former treated as a nullity. A number of petitions have been filed looking to that end, the object being to treat the appeals and everything done in pursuance thereof as utterly void, and asking that the cases proceed in all respects as if no action in that behalf had been taken. It is not difficult to see the results of granting and conforming to those petitions. It would disturb vested interests and open up controversies and litigations which have been determined, and decisions made in that behalf and acquiesced in. If the findings of the Commissioner in this case were a finality, and the interests of all parties to this interference were to be definitely determined, I would still be slow to consent to reopen the case or disturb the condition of things resulting from the action of the Secretary.

"Touching the question as to whether the Commissioner has by his indorsement upon the decision of the Secretary consented to or ratified the judgment entered by him, I submit that if it were necessary, in order to secure an end to litigation and to avoid the vexatious consequences which would result from reopening a large number of cases heretofore determined by the Secretary, in the exercise of what was supposed to be his rightful jurisdiction, I would have no difficulty in holding that the failure on the part of the Commissioner to object to the overruling of his decision, and his acquiescence in the order entered in that behalf as evidence by his allowing the proceedings in interference to go forward under and by his authority as the head of the bureau, was such an adoption and ratification of the ruling of the Secretary as to interpose a valid objection to the Commissioner subsequently treating it as a nullity. It is sufficient to say that I shall in no instance disturb the judgment of the Secretary in cases like the present. In this case the decision of the Secretary will be treated as if rendered by the Commissioner, and all proceedings in the matter of the interference will conform to the terms of said decision; in other words, the office adopts the judgment as it finds it and the situation as it is, and all proceedings will be had in conformity thereto."

Electric Gas-Lighting Patent Suits.

It is well known that the electric gas-lighting interests of this country have long been in litigation. Mr. A. L. Bogart, of this city, who instituted a number of suits against infringers of his numerous patents last year, informs us that the first two of the series were decided in his favor on the 25th of last month, in the Circuit Court of the United States for the Southern District of New York. He says:

The patents included in these suits are important, insomuch as in suit No. 1 the claims cover the method of operating an electric gas-lighting burner by means of a lever, chain or wire; the use of a stop-cock in combination with an electric gas-lighting device, in which by the turning of a cock the spark-producing mechanism is operated, and the use of a ratchet and pawl or their equivalents to produce the same results.

The objects of suit No. 2 were to demonstrate the validity of the Tirrell patent of 1880 for what is known as an automatic burner when operated by two magnets "by single impulses," and Mr. Bogart's sole right under such patent to manufacture, vend and use the same in the States of New York, New Jersey and Pennsylvania.

The decree provides that the complainant shall recover profits and damages resulting from the infringement of his patents.

Mr. Edison as an Electrical Litterateur.

A long article signed by Thomas A. Edison, "copyrighted," appeared in the Boston *Herald* of Jan. 18, and we believe in other papers. We quote a few passages. With regard to telegraphy he says:

Nothing of any startling character can be expected of the electrical telegraph. The business has been so long established, the improvements so numerous, that very little remains to be done. Some day there will be, no doubt, a sextuplex system, which will make one wire do the work of six. While none so far tried has succeeded commercially, the expanding magnitude of telegraphy makes it a necessity. This will enable the present telegraphic plant to do more work, and lessen the investment necessary for the installment of any future plant. The necessity for economic running expenses must lead to the use of a system of autographic telegraphy, which will enable the telegraph companies to dispense with most of their skilled labor. This, too, will be more satisfactory to the public, as such a system will reproduce at the distant station a fac-simile of the message as written by the sender. Several inventions of this character have been put into experimental use, and their adoption is merely a matter of time. The increase in the volume of cable business and the demand for lower tariff rates must lead to improvements in submarine telegraphy. The duplex system is already used in several of the Atlantic cables, giving one the capacity of two as worked by the ordinary methods. The quadruplex system will unquestionably soon be applied as in the case of land telegraphy. Again the companies engaged in city telegraph business, in order to insure greater promptness in the delivery of quotations, will be compelled to put into use telegraphic printing instruments having far more rapid action than those now in operation. The companies already recognize this need and are seeking to produce an instrument which will satisfy the needs of the mercantile community. The experiments now in operation are, in the opinion of the writer, on a false basis. The printing on the tape is obtained by the operation of mechanism, through electro-magnets. Inventors seek to augment the rapidity of the printing by increasing the rapidity of the mechanism. The improvements to be attained by this means can be but slight, as the increased speed at which the mechanism can be run is very limited. Inventors will be compelled to adopt an entirely different principle from that which controls the present construction. When experience has demonstrated this error, it will not be difficult to secure inventions competent to deliver quotations at a speed equal to the most exacting demands. But all these improvements are but minor ones, such as the requirements of telegraphy will evolve in the very nature of things.

The future of the telephone is thus treated:

The development of the telephone is in its very infancy. In the first instance those in the centres of cities alone had the advantages of telephonic service, then the suburbs were reached, and, later on, towns adjacent. The service in cities is by no means satisfactory, and between cities and towns adjacent it is far more inefficient. The business has reached such magnitude that it has outgrown the present equipment. The company controlling the telephone business in this country fully recognizes this, and is working with all the talent which money and interest can obtain to improve the service. The result will be greatly to the advantage of the public, and consequently to the commercial development of the telephone. The tariff rates are now so high as to preclude the average householder from taking advantage of the service unless a number of subscribers are all connected with one wire. Of course, this is objectionable, as each subscriber on the wire hears whatever conversation is going on over it. Recent experiments have shown that all this may be obviated, and that one of a number of subscribers on the same wire may have his own words secure against eavesdropping. The perfecting of these experiments will lead to great extension of private house business, and the telephone will come within the means of the ordinary householder.

The efforts made with a view to long-distance telephoning have already proved quite satisfactory in a commercial way and promise excellent results. Conversation has been conducted between Cleveland and New York, and is now daily carried on between New York and Boston to a limited extent. The great difficulty in long-distance telephoning is the loss of the current by static induction on the earth and wires in close proximity. If a single wire could be placed sufficiently high to amply clear all the mountain tops, one could whisper around the world with perfect ease; or if a wire could be stretched from the earth to the moon, the connection would also be adequate. Perfect results were recently obtained on a government line in Arizona, a distance of about a thousand miles, the wire stretching over a treeless space of country, more perfect far than can now be had between New York and Hartford. The loss of the electrical energy by static absorption and the running together of the electrical waves is the fact that utterly precludes the possibility of submarine telephoning across the ocean. One thing, however, is now certain, that the time is close at hand when the telephone will be perfectly successful in an unbroken circuit for a distance of at least 300 miles; and that a subscriber will be able to communicate with 75,000 commercial houses. More than this, even, it is probable that by means of repeating stations communication can be had over all parts of the United States. To attain the results of long-distance telephoning, however, special instruments and a very heavy investment in plant will be required. The writer does not hesitate to predict, from the success of experiments already made, that the subscribers in New York will by and by be able to converse with Philadelphia, Washington, Providence, Boston, and possibly with Chicago, with as much facility as telegraphic business is now conducted. Though it would at first glance seem to be the case, it is not likely that the prosperity of the telegraph companies will be diminished. The telephone, in the very nature of things, supplies a need that the telegraph cannot possibly meet.

Then comes the electric light. Of this he says:

The changes wrought by the telegraph and telephone will be equaled, if not eclipsed, by the transformation wrought through electric lighting. Two years' experience proves beyond a doubt that the electric light for household purposes can be produced and sold in competition with gas. When it is remembered that, next to that of railways, the business of gas illumination is the greatest commercial and industrial enterprise in the world; that in the United States alone there were 863 gas companies in 1883 with a total capitalization of about $290,000,000; that in New York City, in the same year, the gross revenue to the gas companies was $9,600,000, of which $4,600,000 was net; and that the total number of consumers in New York was 120,000, supplied through 860 miles of mains, it will be seen that the possibilities of electric lighting are enormous. It is not likely that the arc light will take any considerable share of this business, or that it will be at all a serious competitor to the gas companies. The demand for an intense light is limited. The remunerative business of gas companies is in the supply of light to the ordinary consumer. It is here that the incandescent light finds its field. Though this system of illumination is only two years old, there are now 21 towns and cities which have central stations actively at work, and numerous other places will have plants installed during the coming year. The incandescent light is the most perfect form of artificial illumination yet produced. It gives a light absolutely steady, without any deleterious properties. It does not burn the oxygen gas out of the atmosphere, nor give it carbonic acid gas, and it is very pleasing to the eye. The consumer buys his electricity, measured on a meter, which registers consumption with far more precision than can be attained in any gas registering meter. It is immaterial whether the electric energy is used for light or for other purposes. It is so easy of control, the apparatus required so inexpensive, that it can be used as a motor power for purposes innumerable. In a house it can be used to drive miniature fans for cooling purposes, to operate a sewing machine, to pump water, to work a dumb waiter or an elevator, and for a hundred other domestic uses which now require personal labor. In places where small steam engines are used at great expense, owing to the special attendance requisite, the electric moter will be invaluable. Electricity as a lighting agent has the great advantage over gas that it can be used at will for motor purposes, and that its operation for the latter purpose is as simple as for incandescence, which is effected by the mere turning of a key like a gas-cock. The function of electricity as a motor for household purposes will be hardly less useful than its value in illumination.

Coming to the consideration of power, he speaks of the present methods and machines for producing current as "very cumbersome and expensive" and tells what will happen when electricity is produced directly from coal. He speaks most hopefully of electric railways, and says:

There will be no difficulty in applying the electro-motor to long trunk lines of road. The track may be divided into 16-mile sections, and the electric station will supply the energy eight miles each way through a centre rail, which will of course be thoroughly insulated. So many of the disagreeable conditions of railway travel, smoke, cinders and much of the disagreeable noise will be obviated, while all the conditions of speed, comfort and safety will be as well or better served than at present. As a matter of economy to railway companies, and therefore of cheap rates of travel for the public, the writer is convinced of the great commercial value of the electric motor.

Various experiments have been made with a view to the electric propulsion of carriages, cabs, drays, etc. The drawback has been that the power has been obtained from secondary or storage batteries, the depreciation in which is so rapid, and the weight of the receptacle so great, that, until some radical improvements are made in connection with the storage of electricity, or the production of the same directly from the coal, we cannot hope to see the subtle fluid used as a means of propelling street conveyances. Still, daylight begins to shine on the problem, and the writer has no doubt that, eventually, most of our trucks and cabs will use this power. When this time comes, we shall find the scope of electricity vastly widened, and see carriages without horses, yachts without steam or sail, and many other novel adaptations. The problem of aerial navigation, too, will then be easily solved.

For Chicago Photographers.—Blomgren Bros., photographers of Chicago, have put in a large focusing light of the Thomson-Houston system.

WESTERN NOTES.

THE ELECTRICAL WORLD BRANCH OFFICE,
CHICAGO, Jan. 20, 1885.

There is considerable complaint from the mechanical telephone people in Chicago that their lines are cut frequently. The Bell Company's lines do not suffer.

The Great Southern T. & T. Co. issue a circular announcing that their net earnings (about $6,000 per month) will be devoted to the construction of long lines connecting the large plantations along the Mississippi with New Orleans. This work will probably make it impossible for any dividends to be paid before next October.

The Central Union Telephone Company, Chicago, pay their stockholders a dividend of 1½ per cent. for the quarter ending Dec. 31, 1884. This is the first dividend paid by the company in something like a year. It is expected that quarterly dividends will be paid regularly hereafter.

The Western electric factory at Chicago had a narrow escape from fire on Saturday, the 17th inst. Large quantities of smoke were discovered coming up from the basement into the offices early in the morning, and investigation showed that a fire, which had started from the large ovens in the Patterson cable department, was just about ready to break through the floor, and only prompt action prevented this. Had the fire got through the floor, it would have at once communicated with the wood-work department, and nothing could then have saved the large wing, containing the cabinet, insulating and foundry departments, from being destroyed, and in all probability the whole building would have gone.

The name of the Van Depoele Electric Light Company, Chicago, has been changed to the Van Depoele Electric Manufacturing Company, and the business will hereafter be carried on under the latter name. The new company have made arrangements for a larger and more convenient factory. The company have lately sent a large incandescent outfit to South Bend, Ind., and another incandescent plant has been placed by them in Brand's Brewery, Chicago. They are just shipping out a 40-light arc plant to Jackson, Mich., which will just double the plant which they already have there. A smaller arc plant is all ready to go to Little Rock, Ark.

The Badger Electric Company are getting estimates on engines, boilers, etc., for increasing their 100 arc light plant at 10–12 Arcade Court, Chicago, to a 300-light plant. The plant, as it now stands, has 75 Fuller lights and 25 Excelsior.

The United States Cosmo Electric Panorama Company is the name of a concern recently organized in Chicago. Their project is a somewhat remarkable one. Instead of offering a tour around the world in eighty days, they propose to give the public the opportunity to make the journey in a single hour. Electricity is an important factor in their plan, and it is claimed that their panorama will eclipse anything in this line yet produced. The building is to be 160 feet in diameter and 240 feet from base to top of dome, and the exterior will be handsomely illuminated by electric lights. On a level with the entrance will be the electric and mechanical contrivances, and on the structure, 80 feet in height, which contains them will be a large globe, 80 feet in diameter, representing the earth. By means of paintings the globe will be given the appearance of being suspended in mid-air. On the top of the dome will be an electric light arranged so as to represent the sun. There will be a gallery in the form of a winding stairway, passing along which the spectator will get a bird's-eye view of what is transpiring on the earth's surface. The globe will show the daily and yearly motions of the earth. The electric contrivances will be so accurately adjusted that the movements of the different bodies will seem to be controlled by gravitation. Chicago already has several panoramas, but this is the first to employ electricity so largely.

The Sperry Electric Light Company, Chicago, have lately been running night and day, and are still behind their orders. They find their present factory entirely inadequate, and Spring will probably see an extension of their works. They have now several subsidiary companies, and at Omaha, Neb., have just had erected for their local company there an unusually fine electric-lighting station. At San Francisco they have a very strong local company also.

The Weston incandescent system has lately been introduced into the government building at Chicago.

The Chicago & Western Indiana Railroad Company have contracted for a 50 arc light plant for their new Polk street depot, Chicago. They will use the Western Electric Company's apparatus. The latter company have lately put in operation a large plant in St. Paul, Minn., and are just commencing work on the apparatus for the 330-light plant for the West Side Driving Park Association, Chicago. The plant is to be in operation by summer.

The Western Electric Company, Chicago, report business in the electric bell, annunciator and mercurial fire-alarm lines as very brisk. Among the new buildings recently fitted up by them may be mentioned that of the Northwestern Safe & Trust Company, a mammoth structure on the corner of Adam and La Salle streets, Chicago; the Adams Express Building, Chicago; Hotel Royal, New Orleans; Montezuma Hotel, Las Vegas, New Mexico; and the Republican House, Milwaukee, Wis.

The great sleet storm of the 16th, with its centre at about

Cleveland, Ohio, badly demoralized the telegraph service in the West. At Chicago, Eastern business was accepted by the different companies "subject to delay." West of Chicago the snow was too dry to cling to the wires, and the lines were in good order. On Saturday, Mr. McCullough, of the Bankers & Merchants' Company, said that up to eleven o'clock his company had received the only grain quotations from New York posted on 'Change at Chicago. They had kept their duplex wire running all the morning. All the companies at Chicago claimed to have the only clear wire to New York, and all agreed that it was the greatest sleet-storm since the spring of 1883. By Saturday night, all the companies had their lines east from Chicago in such shape that they were taking care of business that was offered them very satisfactorily.

THE TELEGRAPH.

Augusta, Ga., is seriously discussing the question of an electric fire alarm.

Earnings.—The gross earnings of the Mexican Telegraph Company for the week ended Jan. 10 were $3,552, and those of the Central & South American Company $6,928.

Telegraphic Communication at Sea.—Telegraphic communication has been established between a sunken lightship and the shore at Ramsgate, England. The messages are conveyed direct to the local post-office. This means of communication will be of great value, as the lightship will be connected with several others, and it will enable assistance to be dispatched to distressed vessels with much greater promptitude than heretofore.

Officers of the Commercial Telegram Co.—The annual election of the Commercial Telegram Company—the rival of the Gold and Stock Telegraph—was held on the 18th, and resulted in the choice of the following named directors: J. H. Prall, Richard S. Newcombs, George H. Pell, John B. Scott, A. H. De Haven, Charles E. Quincey, George Turnbull, J. V. Bouvier, Geo L. Hutchings, James G. Smith, G. S. Mott, C. Minzesheimer, S. D. Field, J. G. Case, A. H. Baldwin.

Rufus Hatch's Statistician.—Byron W. Barnard, a former employé of the Western Union Telegraph Company, has a suit pending in the New York City Court against Rufus Hatch for services which he claims to have rendered in collecting information and statistics on the science of telegraphy and in procuring sellers for telegraph stock just prior to the great strike of 1883. The court has decided that Mr. Hatch shall answer the complaint within three days after the service of a bill of particulars which is to be made immediately.

Surviving Thirty-one Injunctions.—A recent dispatch from Galveston, Tex., says: The Baltimore & Ohio Telegraph Company will at once open its offices for business in one hundred and sixteen cities and towns in this State. As this is the first time the commercial circles of Texas have enjoyed the benefits of telegraphic competition, great interest is being manifested in the telegraphic conflict that is about to be waged. Especial interest is exhibited in the new enterprise, on account of its successfully meeting and defeating thirty-one injunctions brought against it by its powerful rival the Western Union Telegraph Company, supported as it was by the mighty influence of the Gould railway system in this State. Rates have been reduced 25 per cent. by the new company, which has been promised much of the business of the leading business houses throughout the State. It is expected that the Western Union will reduce them still more, and an interesting conflict be at once precipitated.

THE TELEPHONE.

Damages Wanted.—The Bell Telephone Company of Canada have instituted an action against the Dominion Telephone Company for over $10,000 damages for infringement of patent.

Nebraska Telephone Company.—This company has had a steady growth, and will pay its seventh quarterly cash dividend of 2 per cent. on the 31st, besides providing for all ordinary extension out of earnings. The surplus will amount to over $10,000 at the end of this quarter.

The Modest "Magic."—Samuel E. Landis, Wilbur F. Hoffman and Josiah Bryan are the corporators and trustees of the Magic Telephone Company, which filed its certificate of incorporation Saturday in the office of the County Clerk, New York. It has a capital of $5,000,000, divided into 100,000 shares of $50 each. Its objects are to buy, sell or lease telephones and telephone appliances, inventions or patents, to organize sub-companies and to buy and sell such real and personal estate as may be necessary to the successful operation of the company.

The Bell Patents in Canada.—A dispatch of Jan. 15, from Ottawa, says: The Minister of Agriculture has not yet arrived at a decision as to whether the Bell Telephone Company has invalidated its patent in Canada by infraction of the patent laws, as shown by evidence taken before him several weeks since. After reading over the evidence, the Minister handed it over to Dr. Tache, his deputy, an expert in patent laws, and, until the latter has carefully gone over it, no decision will be reached. The general impression, however, is that the Bell patent will be declared void.

The McDonough Claims.—On the 15th inst., at Washington, the Commissioner of Patents began hearing argument upon the motion of McDonough, one of the parties to the interference case of Bell vs. McDonough, vs. Gray and others, to refer back to the examiner of electrical devices McDonough's claim, with a view to showing that his invention was operative. The Board of Examiners in Chief set aside the decision of the Examiner of Interferences, which gave to McDonough priority of invention of the telephonic receiver, on the ground that his device was not practically operative.

A Telephonic Cavalliero do Christo.—The King of Portugal has just conferred the honor of Cavalliero do Christo on Mr. Alan Danvers, engineer and manager to the Edison-Gower-Bell Telephone Company at Lisbon. Some little time ago the King was prevented attending the first performance of the opera "Lauriana," through the death of the Princess of Saxony. Mr. Danvers came to the rescue and suggested that he should telephone the opera from the house to the Ajuda Palace. The result proved most satisfactory, as both the music and the words are stated to have been perfectly distinguishable.

Overweighted with Gold.—The telephone company's executive department office effects, at Lowell, Mass., were removed on the 17th, from Hildreth Building to Shattuck's block, on Central street, where the operating room of the company is located. While lowering the company's safe from the third floor at the rear of the Hildreth Building, the rope sustaining it broke, and the safe fell 15 feet with a heavy thud into the alley way, which is concreted. One of the trucks sank into the concrete three or four inches. In its descent the safe did damage to the building. The safe itself was but little damaged. It is supposed that the treasurer forgot to remove from the safe, prior to lowering, the surplus in gold that had accumulated there, and hence the mishap.

Erie Prospects.—The Boston *Herald*, of the 16th, says: "Erie has a debt of $160,000 to $170,000, which it will require a full year, probably, to cancel on the basis of recent net earnings. It is understood that the repair and construction accounts are being reduced to the lowest possible figure in the interest of net income, and it becomes a question whether the condition of the property is being maintained. In 1886 or 1887 (it is believed the former year) the contract of the Northwestern division of the Erie Company with the American Bell expires, and if the latter asks what it is now asking of sub-companies on contracts, $1,500,000 of new stock will, it is understood, have to be issued to the Bell Company as a condition of renewal. This division entered the Erie combination on the basis of $1,500,000 capital."

In Paris.—New Year's Day in Paris witnessed the inauguration of an important improvement. Five telephonic bureaus were opened at well-chosen centres of business or population. The bank was necessarily the most important, and the office of the Grand Hotel gave the greatest facilities to strangers, but Parisians in all directions could avail themselves of the offices temporarily opened near the Madeleine, in the Rue de Grenelle, on the Boulevard Malesherbes, and in the great centre of the Halles. The use of these offices was not restricted merely to subscribers. The public had access to all of them, and the scale of payment was fixed by time, and a charge of half a franc laid down as the unit of payment. This secured five minutes' uninterrupted conversation, with the privilege of ratable protraction of the time.

THE ELECTRIC LIGHT.

Akron, O.—The Thomson-Houston lights at Akron, O., now number nearly 200.

Dividend.—The New Bedford, Mass., electric lighting company has declared its quarterly dividend of 2 per cent.

Lyceum Theatre, New York.—This new home of the drama, which is to be as perfect in its arrangements as possible, will be lighted by electricity.

Increase in Pennsylvania.—The Thomson-Houston Electric Company have increased their plants in Pennsylvania by over 250 lights during the past 30 days.

Easton, Md.—Messrs. H. B. Wilmer and H. A. Clark, of Baltimore, and Mr. C. B. Story, of Williamsport, Pa., have been at Easton, Md., making arrangements to introduce electric lights. They are negotiating for a building in Easton.

In Norway.—The electric light having been introduced in a portion of the government buildings in Christiania, Norway, the experiment was so satisfactory that its wide employment is certain. The installation was by Messrs. Patterson & Cooper, of London, England, and this firm has also fitted, through their agents in Norway, the Devolds wool and weaving mill, the Gjethus paper mill, Nilsen & Mathiesen's saw mills, the Hagholmens shipyard and the Rustlok Bahkens bazar.

Lighting by Chromozone Batteries.—Mr. Charles Penruddocke, of Compton Park, has his drawing-room brilliantly lighted by incandescent lamps, maintained by chromozone batteries. He states that the expense is very moderate, considering the difference in brilliancy between the electric light and gas, and the steadiness of the light is remarkable. The batteries are said to be cheap, simple and easy to maintain, and not to require changing more than once a week.

Conshohocken, Pa.—An effort to establish an electric light company in Conshohocken has been pronounced a failure. Several causes have contributed to such an end. In the first place to secure any degree of success it would need the encouragement of local capitalists. Most of these have a first love in the gas company and consequently not much more than apathy, to put it mildly, for the new light. Then several of the large mills have put in plants of their own.

Fourth Semi-Annual Dividend.—The directors of the Rocky Mountain Electric Light Company have declared their fourth semi-annual dividend, making a total of $20,000 in two years. The capital is $100,000, divided into 5,000 shares, and the dividend is $1 per share, or 10 per cent. per annum. The electric light business does not suffer from hard times, but continues to grow rapidly into popular use. The Rocky Mountain Company, under the able management of Major Erb, has become one of the solid institutions of Salt Lake.

Amenities at Lockport, N. Y.—A dispatch of Jan. 16 from Lockport tells the following story: Two electric light companies are having a hot fight for the privilege to light Lockport by electricity. A company was formed here about two months ago to introduce electric lighting, and it obtained from the city government the right to erect poles and string wires in the streets. After this the gas company, a monopoly of long standing, bought a controlling interest in the electric company, and it was thought this would end the electric light business, but on Monday night a new company appeared before the Common Council and obtained the privilege to light several streets by electricity in place of gas. This afternoon in the midst of a driving snowstorm the gas company commenced with a large force of men to pull down their gas posts and put up electric poles in place of them in Main street, which right had already been given by the Council to the new company. A war of words between officers of the two companies occurred, but work was continued without interruption. Trouble is expected in future.

MISCELLANEOUS NOTES.

An Electric Storm.—During the passage of the American Line steamship British King, which arrived at Philadelphia last week from Swansea, she encountered a blinding electrical storm, such, perhaps, as has never before been experienced by a transatlantic vessel. The ship was off St. George's Banks during a heavy rain and thunder storm. The electricity in the atmosphere became so intense that it blinded the men on the lookout, and as a precaution against accident the engines were stopped. The horizon, as far as the eye could reach, was flashing with vivid and continuous sheets of lightning. At the same time St. Elmo's fire appeared on the yard-arms and mast-heads in the shape of luminous meteors.

A Tropical "Roman Candle."—A correspondent of one of the Panama papers, writing from the interior of the country, ventures on the following: During the past two months we have been exposed to horrible tempests, which in some places have swept down entire forests. On Oct. 26, in the midst of a severe storm, we experienced a heavy earthquake, and on Nov. 10 we were visited by a breeze which was so pestilential as to be almost insupportable. On the 8th at daylight a number of people were dancing at the Taclic mine, when they were horrified to see that one of the tallest trees in the neighborhood suddenly became charged with electricity, and that sparks flew from it to the ground, increasing rapidly in number until the whole foliage appeared to be in a blaze. At the same time a remarkably clear light shone from the tree, from which balls of colored fire seemed to fly in all directions. Gradually the brilliancy of this light disappeared, and two hours afterward the tree wore its usual appearance, without boughs or leaves having suffered the least injury. The dancing was at once suspended and the people, terrified in the extreme, threw themselves on the ground and prayed for divine mercy.

APPLICATIONS OF POWER.

Electric Power for a French Railway.—The Compagnie Electrique has put down an electric plant at Vitry, for the Compagnie de Chemin de Fer d'Orleans. A No. 5 electric generator, driven by a steam engine distant about 180 metres (590 ft.), yields, at 1,100 revolutions a minute, a current the tension of which does not exceed 140 volts. The No. 3 electric motor, placed in a cellar, gives out 50 kilogrammetres (361 foot-pounds), working a rotary pump and other machinery.

Boston Waiting.—The Meigs Elevated Railroad Company are evidently preparing to experiment for the next few years upon the location of the Boston & Lowell road. Meanwhile prominent capitalists are quietly watching developments connected with the operations of elevated railroads by electricity, with the belief that street railway management will result in a very loud call for a substantial system of elevated railroads in Boston before many years.—*Boston Journal.*

A Traveling Crane Worked by Electricity.—For some years past a traveling crane has been worked by current at the Bourges Cannon Foundry, in France, and M. Marinoni is now turning his attention toward applying the same system to a traveler 20 metres long and 7 metres high (65 by 23 ft.), with a travel of 90 metres, or 295 ft., at his Paris works. A No. 5 motor of the Compagnie Electrique makes the lift (up to six tons), while a No. 4 serves to effect the traveling motion. At 1,100 revolutions the generator gives out a current the E. M. F. of which does not exceed 250 volts.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange, and elsewhere, are as follows:

TELEGRAPH.—Am. Cable, b 52, a 55; B. & M., b 3⅛, a 7; Mutual Union, b 11, a 13½; Postal Stock, b 1, a 3; Postal sixes, b 25, a 27; Western Union, b 57⅛, a 57¼.

TELEPHONE.—Am. Bell, b 243, a 244; Erie, b 19⅜; Mexican, b 1½; New England, b 33, a 34; Tropical, b 1½.

The Boston *Herald* of Jan. 21, says: Bell telephone shares advanced to 246, falling back to 244. It is estimated that for 10 months to Jan. 1, the end of the new fiscal year, the company earned $1,377,000 net, and that January and February will add enough to the net revenue to make the earnings for the fiscal year, as formerly reckoned, about 18 per cent. on the stock. The company is gradually acquiring control of all of the sub-companies, and the more its dividends accumulate, the more it becomes apparent that, practically, the only money to be made in the telephone business is by the parent organization. It is understood that the contract of the Southern Massachusetts company with the American Bell expires in 1886, and the price of renewal will presumably be 50 per cent. of the stock. It has been remarked by some writers that an increase of American Bell capital stock will illustrate the "watering" process. As the stock would have to be sold at par by the company, the "watering" would, at most, be indirect.

ELECTRIC LIGHT.—Edison, b 62½.

BUSINESS NOTICES.

Removal.—J. H. Bunnell & Co. have moved to their fine new store, Liberty and Church streets, where they enjoy increased facilities for handling their large and growing trade.

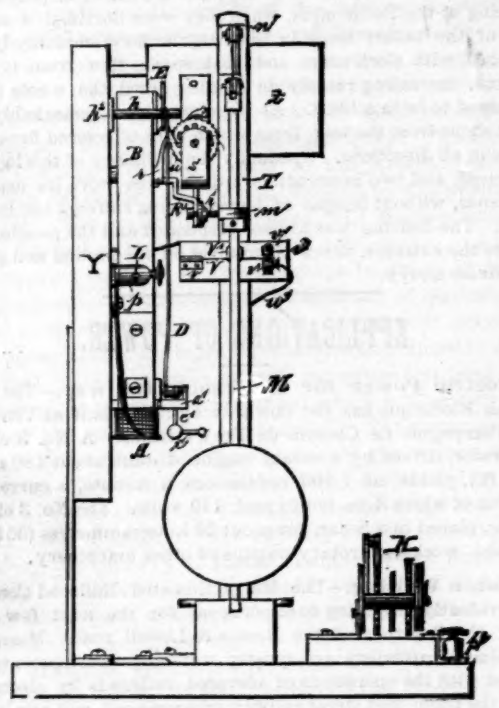
Miniature Electric Lamps.—G. H. Stout & Co., 21 Ann street, New York, are agents for the sale of miniature Edison lamps. These ingenious little lamps are intended for household, experimental and ornamental purposes, with the Meadowcroft & Guyon pocket battery. The lamps are of ½, 1, 2, 3, 4 and 6 candle-power, and special dental and surgical lamps can be had. The battery can be comfortably stowed away in the pocket and the lamp adjusted in the necktie, or on the hat or wherever required. There should be a large sale for these cheap and excellent novelties.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JAN. 6, 1885.

Apparatus for Measuring Electricity; Jules Cauderay, Lausanne, Switzerland..... 310,252

The letter *A* indicates a vertical galvanometer arranged between the dependent legs of a permanent horseshoe magnet *B*, which is secured to a vertical back board *Y*. To this shaft of the galvanometer needle is fixed an upwardly extending pointer *D*, which is held normally in a true vertical position by an adjustable counterweight *c* upon an arm *c'*, projecting downward from the shaft. Behind the upper end of the pointer *D* is arranged a horizontal scale *E*, graduated to the right and left from a central zero point. Immediately behind the pointer *D*, which is of metal, a fine platinum wire is stretched between two metallic



arms *h*, one of which projects from a metal plate h^2, which is connected by a wire with one terminal of coils of an electro-magnet, the other terminal of which is connected by a wire *w'* to a binding post p^2, from which a wire leads to one pole of a battery, the other pole of which is by a wire connected to a binding-post.

Apparatus for Measuring Electricity; E. Caude-ray, Lausanne, Switzerland..... 310,252

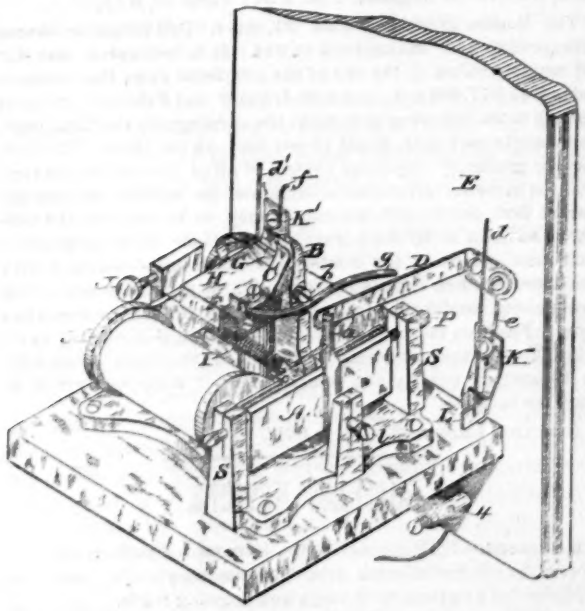
The letter *A* indicates a vertical galvanometer arranged between the dependent legs of a permanent horseshoe magnet *B*, which is secured to a vertical back-board *Y*. To this shaft of the galvanometer needle is fixed an upwardly-extending pointer *D*, which is held normally in a true vertical position by an adjustable counter-weight *c*, upon an arm *c'*, projecting downwardly from the shaft.

Behind the upper end of the pointer *D* is arranged a horizontal scale *E*, graduated to the right and left from a central zero-point.

Immediately behind the pointer *D*, which is of metal, a fine platinum wire is stretched between two metallic arms *h*, one of which projects from a metal plate h^2, which is connected by wire with one terminal of the coils of an electro-magnet, the other terminal of which is connected by a wire *w'* to a binding-post, p^2, from which a wire leads to one pole of a battery, the other pole of which is, by a wire, connected to a binding-post.

Telephone Signaling Apparatus; J. H. Cary, Boston, Mass., Assignor to the Cary Telephone Signal Co., Portland, Me..... 310,379

The polarized armature *B* is adapted to be attracted against



the force of the spring *G* by a light battery current of proper polarity, not of sufficient strength to attract the neutral armature. Such a current being sent, the attraction of the polarized armature will cause the upper end of said armature to make contact with spring *C*, which will complete the local circuit through the post *H* and metal frame and standards *S*, pivots *P*, armature *A*, rod *a*, spring *D*, wire *e*, spring *K*, angle piece *L*, wire *d*, then through the bell-magnet, etc., thus completing the local battery circuit and ringing the bell.

Metallic Curbing for containing Electrical Wires; P. H. Griffin, Detroit, Mich..... 310,271

Consists in making the usual curbing of streets in the form of a rectangular box.

Apparatus for Refining Sulphur; F. Dickert, Salt Lake City, Utah..... 310,187

Consists of a vat for purifying sulphur, provided with a longitudinal discharge-passage separated from the main body of the vat by a reticulated or apertured cover extending the length thereof, in combination with a furnace under said vat.

Apparatus for the Electrical Separation and Deposition of Metals; B. Moebius, Chihuahua, Mexico, Assignor of three-eighths to W. E. Pope, Athens, Ga..... 310,333

Consists of first coating the cathode with silver and of suspending both electrodes in a bag; and of pulleys arranged above the vats, whereby any number of electrodes may be lifted simultaneously.

Binder for Electrical Conductors; J. Brady, Brooklyn, N. Y..... 310,177

He constructs the binder with a fixed and a movable jaw, each provided with a broad or extended clamping face, and adapted to be brought together by means of a screw, and thus bind the wire between their respective clamping faces; and he also provides the base of the binder with an attaching metallic stem, and an inverted cupped disc extending out over and covering the underlying insulation, whereby the rain or other matter falling about the binder is kept away from the insulation and shed from the edges of the cupped disc, thus protecting the insulated joint of the binder from injuries or leaks. He prefers to construct the movable clamping jaw in the form of a yoke provided with a screw passing through one side or extremity and having a clamping face upon the opposite side or extremity, in combination with a fixed jaw arranged within said yoke between its clamping face and said screw, and provided with a clamping face opposite the clamping face upon said yoke, whereby the conductor may be secured between said jaws by the pressure exerted by the screw upon the fixed jaw.

Electric Pneumatic Clock System; C. A. Mayr-hofer, Vienna, Austria-Hungary, Assignor of one-half to C. Diener, of same place..... 310,530

The object of this invention is to provide means by which any number of clocks connected together by hydropneumatic means may be wound and correctly set every time an electric circuit is closed by a central or standard clock. For this purpose each time the electric circuit is closed by the central or standard clock, a liquid under pressure is made to compress a quantity of air and wind up and set all the secondary clocks in the entire system. The invention accomplishes this by first making an electric circuit open or close valves in pipes containing liquid under pressure, and secondly, the liquid in its turn compresses air and operates the mechanism to produce the result required. The clocks in this system may be of any desired construction—that is, any of the well-known self-acting clocks in common use.

Thermal Cut-Out; Wm. Stanley, Jr., Pittsburgh, Pa..... 310,472

Consists of an air-chamber so arranged in proximity to or sur-

rounding an electric conductor *D* that the heat generated in the conductor by reason of an abnormal current shall effect a rupture of the conductor by expanding the air in the air-chamber, and thereby displacing a movable body of mercury *E* arranged to close such chamber, and connected with or constituting a part of such conductor.

Electrical Conductor; H. C. Watt, Philadelphia, Pa..... 310,345

Consists of an electric conducting-wire having a coating of gum turpentine, coverings of hemp or linen braid, coatings of metallic or water-proof paint, a covering of braided wire, and an exterior of tar.

Incandescent Electric Lamp; C. A. Hussey, New York, N. Y., Assignor to the Hussey Electric Light & Power Company, New York..... 310,516

Consist of an extra filament constituting a resistance device, inclosed in the bulb, and means whereby a greater or less length of the said extra filament may be switched into or out of the circuit.

Manufacture of Telegraph Conductors; A. A. Cowles, New York, N. Y., Assignor to the Ansonia Brass & Copper Co., Ansonia, Conn..... 310,258

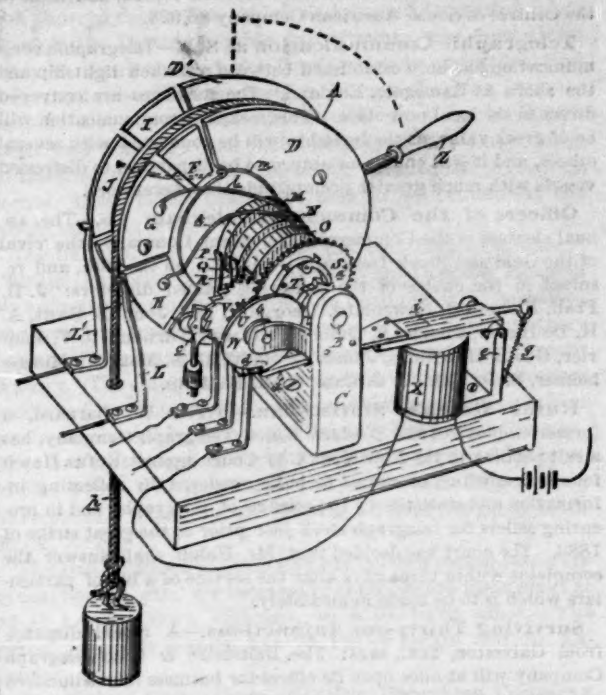
Consists in uniting the diagonally cut ends of lengths of wire by silver solder, and then drawing the wire down to the proper size and stiffness, substantially as set forth.

Railway Signal; C. R. Johnson, New York, N. Y., Assignor to the Union Switch & Signal Co., Pittsburgh, Pa..... 310,519

A plate is provided with two holes, into which the ends of the respective rods are permitted to descend, though not both at the same time, thereby throwing the one blade or the other into position to indicate "safety," accordingly as the switch has been locked in one position or the other. The hereinbefore-mentioned plate is coupled to the system of levers employed for operating the switch from the signal tower. The rods are normally held up by a special supporting-lever, so that although the plate may be moved into position to allow one or the other of the signal-rods to fall, nevertheless it will stand in its raised position until the locking-levers have been actuated and the special lever moved, thereby allowing the rod to drop through the corresponding hole in the plate. It will be understood, therefore, that a signal cannot be moved into position to indicate "safety" except when the switch is set for either the main track or the siding, by reason of the controlling-plate, and also that by reason of the supporting-lever they are not in practice so moved except when the switch is also locked in the position which it has assumed.

Telephone System; W. A. Jackson, W. R. Cole, Detroit, Mich., Assignors to the Western Electric Co., Chicago..... 310,282

Consists of a mechanically impelled device by means of which, at the proper moment, all the switches are automatically operated in their order and for the necessary time interval, said device being also adapted to restore all the switches simultaneously to their normal position. Normally the switch is in the position shown in the drawings, with the contacts for the telephone and test circuits closed, and the operator is at liberty, as far as the condition of the switch is concerned, to establish his telephone and test circuits on the switch-board; but as soon as the test circuit is closed by the operator the electro-magnet *X* becomes excited, and, attracting its armature, releases the catch *f* from its engagement with the shoulder *d* of the wheel *W*, allowing the wheel



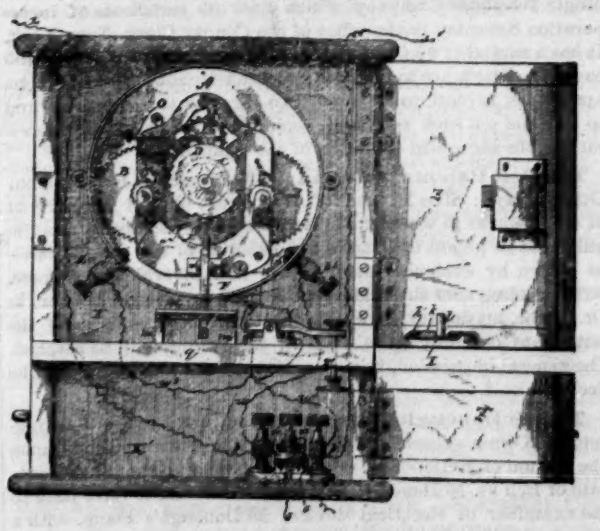
A to revolve. The revolution of the disc *D* first breaks the contacts *L H*, then successively makes and breaks the contacts *L G* and *L F* until the spring *L* comes in contact with the solid part of the disc *D*, when the wheel *A* is arrested by a new engagement of the shoulder *d* with the catch *f*. The revolution of the disc *D'* first breaks the contacts *L' J*, then makes and breaks the contacts *L' I*, and then, after making the contact *L' D'*, it stops. When the revolution of the wheel *A* has stopped, the handle *Z* is in the position shown in dotted lines, and the switch may now be easily restored by the operator to its normal position.

Holder for Incandescent Lamp; T. W. Bryant, Ansonia, Conn..... 310,373

In the lower end of the body are two vertical recesses. Into each of these recesses a helical spring, respectively, is introduced, the diameter of the spring being somewhat less than the recess, so as to leave perfect freedom of the spring. The wire from the upper end of each spring is continued upward through a hole leading from the respective recesses, thence returned through another hole to the bottom of the body, where the ends are secured by springs.

Automatic Fire-Alarm Box; W. C. Hess, Louisville, Ky..... 310,424

The tripping device is a spring *I*, having one end secured to the door of the box and projecting therefrom, so that it will extend into the box when the door is closed. On the projecting end of this spring is a beveled head or catch *k*, the beveled surface *k'* of which strikes the beveled end of the lever *F* when the door is nearly closed, so that by a further inward movement of the door the end of the lever *F* is caused to force downward the catch *k*, so that it will pass under said lever and swing up behind it. If, while the catch *k* is thus engaged with the lever *F*, the



door be open, it is obvious that said catch will force outward the lower end of the lever, causing its upper end to move inward, so that the arm *f* will release the disc *E*; and in order to disengage the catch *k* from the lever *F* after it has performed its tripping function, he provides the spring *I* with an upwardly-projecting lug *l*, which will strike the beveled edge of a plate *M*, supported by legs *m* over the spring.

Visual Electric Signal; F. M. Godfrey, Congdon, Neb..... 310,412

The invention relates to improvements in railroad signals in which an electrical detent works in conjunction with a current-breaker; and the object of the invention is to provide a signal to work when an accident occurs on a railway bridge. When the bridge breaks, the wires are pulled apart and at once break the circuit, thereby neutralizing the magnets in boxes and thereby allowing a reflector to fall, and thus signal.